

358
138



**United States
Department of
Agriculture**

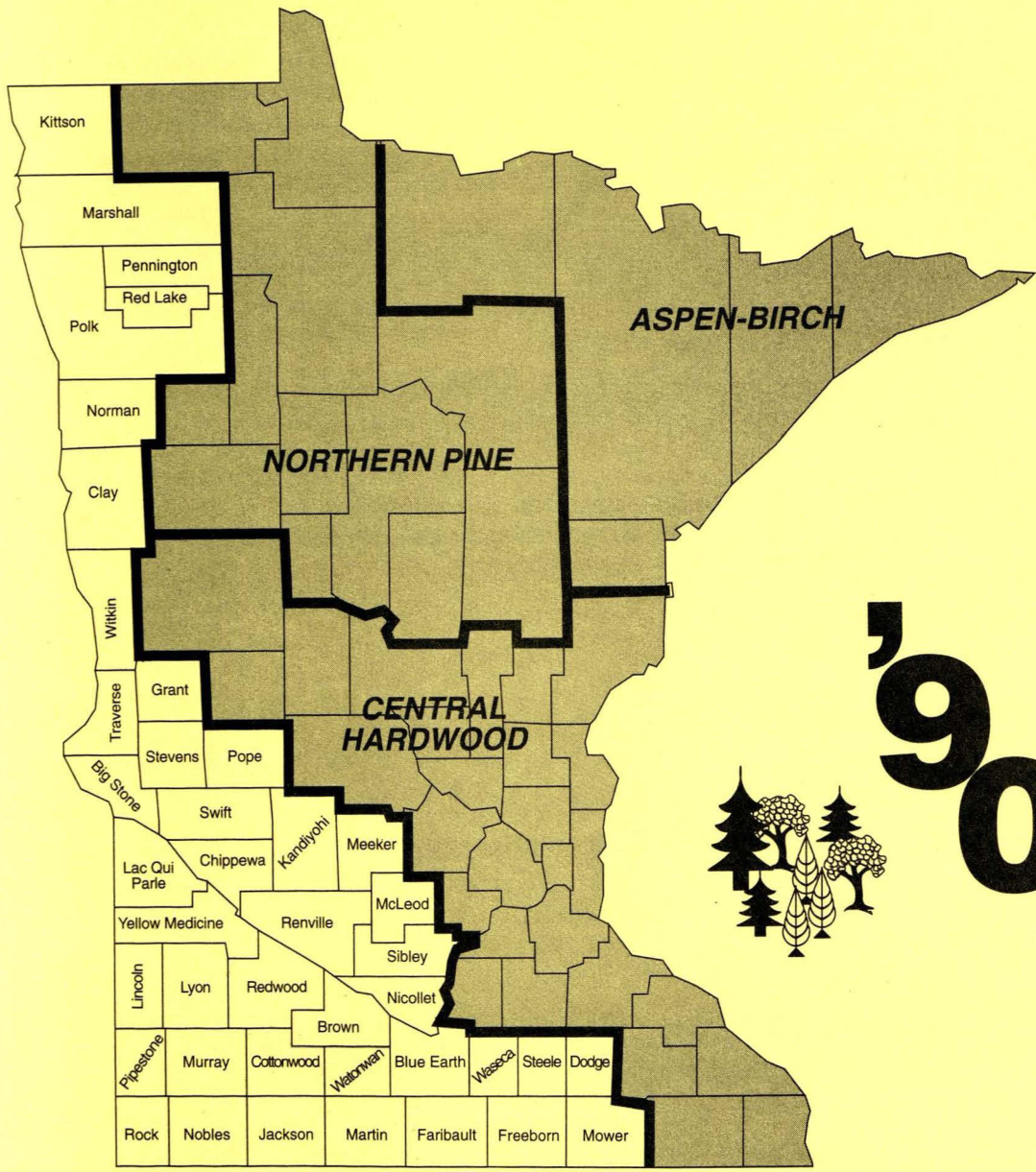
Forest
Service

North Central
Forest Experiment
Station

Resource
Bulletin **NC-138**

Forest Statistics for Minnesota's **Prairie Unit**

Sue M. Roussopoulos



'90



This report includes the most commonly used Forest Inventory and Analysis statistics. Additional forest resource data can be provided to interested users. Persons requesting additional information from the raw inventory data are expected to pay the retrieval costs. These costs range from less than \$100 for a relatively simple request to \$2,000 for a complex retrieval involving the services of a Forest Inventory and Analysis computer programmer. Requests will be filled so as to minimize the impact on the Forest Inventory and Analysis Work Unit.

Requests for information may be directed to:

Project Leader
Forest Inventory and Analysis
North Central Forest Experiment Station
1992 Folwell Avenue
St. Paul, Minnesota 55108
Phone: (612) 649-5139

or

State Forester
Minnesota Department of Natural Resources
Forestry Division
P.O. Box 44
500 Lafayette Road
St. Paul, Minnesota 55146
Phone: (612) 296-6491

Area served: Illinois, Indiana, Iowa, Kansas, Michigan,
Minnesota, Missouri, Nebraska, North Dakota,
South Dakota, Wisconsin

**North Central Forest Experiment Station
Forest Service - U.S. Department of Agriculture
1992 Folwell Avenue
St. Paul, Minnesota 55108**
Manuscript approved for publication March 16, 1992
1992

FOREWORD

Forest Inventory and Analysis (FIA) is a continuing endeavor as mandated by the Renewable Resources Research Act of 1978. Prior inventories were mandated by the McSweeney-McNary Forest Research Act of 1928. The objective of FIA is to periodically inventory the Nation's forest land to determine its extent, condition, volume of timber, growth, and removals. Up-to-date resource information is essential to frame forest policies and programs. USDA Forest Service regional experiment stations are responsible for conducting these inventories and publishing summary reports for individual States. The North Central Forest Experiment Station is responsible for forest inventory and analysis in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin.

Fieldwork for the Minnesota Prairie Unit forest inventory was begun in February 1990 and completed in February 1991. Reports of four previous inventories of Minnesota's timber resource are dated 1936, 1953, 1962, and 1977.

More accurate survey information was obtained during this survey than otherwise would have been feasible because of intensified field sampling. This sampling was made possible through the cooperation and assistance of the Minnesota Department of Natural Resources (MDNR). To aid in determining current timber removals, the MDNR also surveyed primary wood-using plants in the State.

Aerial photos used in the Prairie Unit forest inventory were 1:40,000 scale black and white photos furnished by the USDA Agricultural Stabilization and Conservation Service. In addition, MDNR provided 35mm true color prints at a scale of 1:15,840 of all of the 1977 plot locations for disturbance detection.

Contents

Page

Highlights	1
General	1
Forest Area	1
Volume	3
Timber Growth, Mortality, and Removals	3
Appendix.....	4
Accuracy of the Survey.....	4
Survey Procedures	6
Comparing Minnesota's Fifth Inventory with the Fourth Inventory	10
Tree Grade	11
Metric Equivalents of Units Used in this Report	16
Tree Species Groups in Minnesota	16
Definition of Terms	17
Table Titles	22

Forest Statistics for Minnesota's Prairie Unit

Sue Roussopoulos

HIGHLIGHTS

NOTE: Data from new forest inventories are often compared with data from earlier inventories to determine trends in forest resources. However, for comparisons to be valid, the procedures used in the two inventories must be similar. As a result of our ongoing efforts to improve inventory efficiency and reliability, several changes in procedures and definitions have occurred since 1977. Because some of these changes will make it inappropriate to directly compare the 1990 data with those published for 1977, data from the 1977 inventory have been reprocessed using the 1990 procedures. Please refer to the Appendix section labeled "Comparing Minnesota's Fifth Inventory With the Fourth Inventory" for more details. **The data in this report are subject to change when inventory data for the entire State have been compiled. It is expected, however, that any such changes will be minor.**

General

The Prairie Survey Unit consists of 42 counties stretching from southeastern Minnesota northwest to the Canadian border (see cover illustration). Before settlement, the region was dominated by tallgrass prairie with scattered groves of oaks and gallery forests to the south and aspen parklands to the north (Wendt and Coffin

Sue M. Roussopoulos, Resource Analyst, began her career with the Forest Service at the Rocky Mountain Station in Fort Collins, Colorado in 1980. She joined North Central's Forest Inventory and Analysis Unit in 1989.

1988¹). Frequent fires helped maintain the species composition and treeless nature of the prairie. Today the tallgrass prairie has all but disappeared as agricultural crops now blanket the landscape and trees remain only a minor component of the landscape. Less than 4 percent of the Prairie Unit's 19.1 million acres is forested. Although small in area, these forests are vital in protecting the landscape. They serve as windbreaks, shelterbelts, and wildlife corridors, and they protect against streamside erosion. This bulletin presents statistical highlights of the fifth inventory of Minnesota's Prairie Survey Unit and contains detailed tables of information about forest area, as well as timber volume, growth, removals, mortality, and ownership.

Forest Area

- The Prairie Survey Unit contains 19.1 million acres of land, of which only 3.4 percent or 660 thousand acres are forested (fig. 1). With 139 thousand acres of forest land, Marshall County in northwestern Minnesota is the most heavily forested county in the Unit. Current forest area includes more than 7,500 acres of reserved forest land where harvesting is prohibited by statute or administrative designation.
- Total forest land in the Unit increased by 15 percent from 573 thousand acres in 1977 to 660 thousand acres in 1990. Ninety-seven percent of forest land in the Unit is timberland, up from 93 percent in 1977.

¹ Wendt, Keith M.; Coffin, Barbara A. 1988. *Natural vegetation of Minnesota at the time of the Public Land Survey, 1847-1907*. Biol. Rep. 1. St. Paul, MN: Minnesota Department of Natural Resources. 6 p.

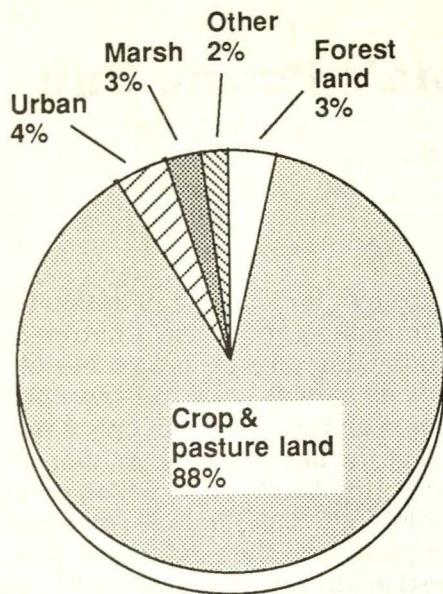


Figure 1.—Distribution of land types in the Prairie Unit, 1990.

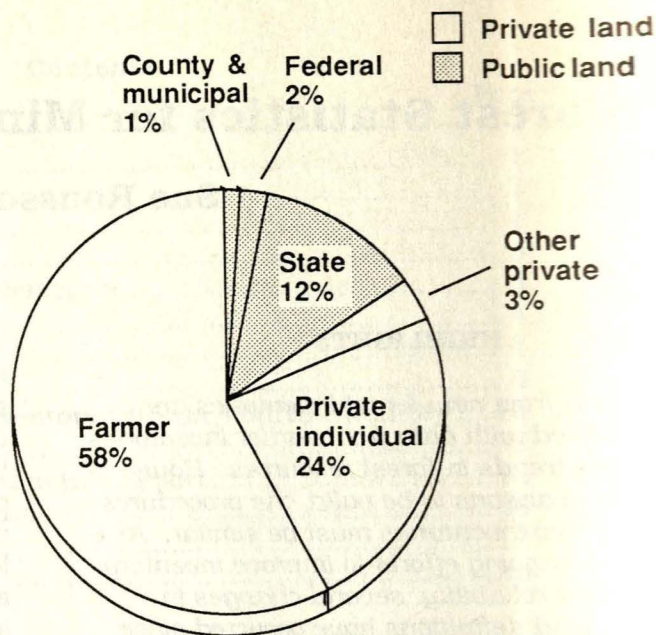


Figure 2.—Distribution of timberland in the Prairie Unit by ownership class, 1990.

- Timberland area increased by 110 thousand acres between inventories. Timberland is forest land that is capable of producing more than 20 cubic feet of wood per acre annually and that is not withdrawn from utilization. Forty-eight percent of all timberland in the Unit is found in the five northernmost counties that make up only 20 percent of the Unit's land area.
- Eighty-five percent of the Prairie Unit's timberland is held by private land owners (fig. 2). Farmers own 68 percent of private timberland; other individuals and corporations own 28 and 4 percent, respectively. The remaining 15 percent is public-owned timberland, of which the State owns nearly 80 percent.
- Four forest types account for more than 90 percent of timberland area in the Unit (fig. 3). Aspen is still the predominant forest type, accounting for one-third of timberland area. An early succession type, aspen declined by 35 thousand acres (14 percent) between 1977 and 1990; the more shade tolerant maple-basswood type increased by 73 thousand

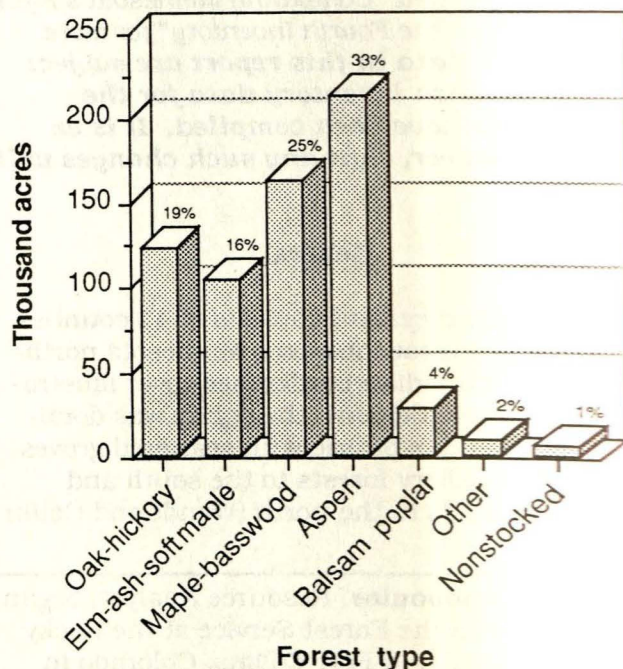


Figure 3.—Area of timberland in the Prairie Unit by forest type, 1990.

acres (83 percent) and now accounts for 25 percent of timberland area. Oak-hickory and elm-ash-soft maple are 19 and 16 percent of timberland area, respectively.

- Sawtimber and sapling-seedling stands make up 49 and 27 percent of timberland area, respectively. The area of poletimber, the predominant stand size in 1977, decreased as stands grew into sawtimber. Poletimber now accounts for 23 percent of area. About 1 percent of timberland area is nonstocked.
- Sixty-one percent of timberland area in the Prairie Unit is moderately or fully stocked with growing-stock trees. Only 7 percent is overstocked.

Volume

- The volume of timber in the Prairie Survey Unit totaled 565 million cubic feet in 1990, an increase of 24 percent from 1977. Average volume per acre is 878 cubic feet.

- Together, oaks make up 26 percent of the 555 million cubic feet of hardwood growing-stock volume, followed by aspen at 22 percent (fig. 4). Basswood and ash account for another 12 and 11 percent of hardwood volume, respectively. Only 2 percent of growing-stock volume is in softwoods.
- Sawtimber volume totaled 1.6 billion board feet in 1990, an increase of 37 percent over the 1.2 billion board feet estimated in 1977. Sawtimber volume averaged 2,496 board feet per acre in 1990.
- Eighty-nine percent of growing-stock volume was on private timberland in 1990 with nearly two-thirds held by farmers (fig. 5). Public timberland volume was 64 million cubic feet. Average volume per acre for private land was 919 cubic feet compared to 653 for public land.

Timber Growth, Mortality, and Removals

- Average net annual growth of growing stock from 1977 to 1989 was 11.7 million cubic

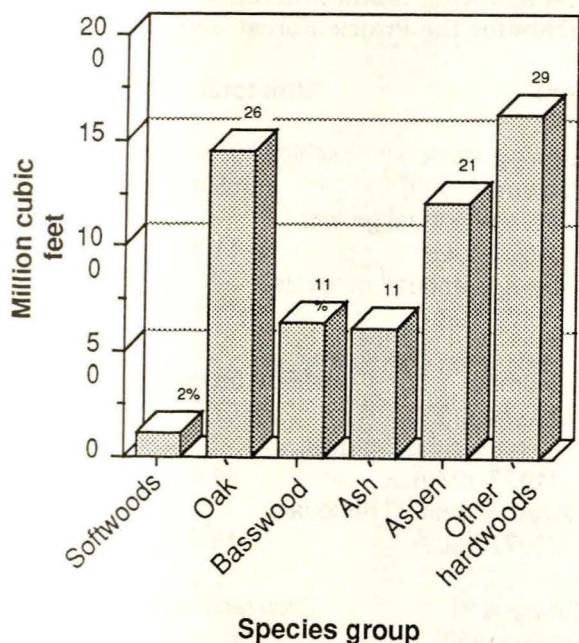


Figure 4.—Volume of growing stock on timberland in the Prairie Unit by species group, 1990.

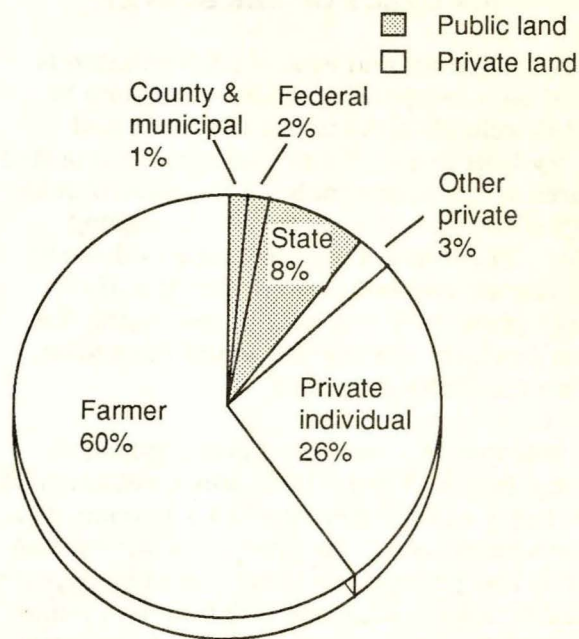


Figure 5.—Distribution of growing-stock volume on timberland in the Prairie Unit by ownership class, 1990.

feet (fig. 6). This is an average of 18 cubic feet per acre per year.

- Annual growing-stock mortality averaged 9.1 million cubic feet or 14 cubic feet per acre from 1977 to 1989. Together, elm (3.4 million cubic feet) and aspen (2.9 million cubic feet) accounted for 70 percent of hardwood average annual mortality.
- Average annual removals of growing stock on timberland for 1977 through 1989 was 7.2 million cubic feet or 61 percent of net average annual growth. Virtually all removals were hardwoods.
- In 1989, growth of growing stock on timberland was 18.2 million cubic feet, or 3 percent of inventory. This is an average of 28 cubic feet per acre per year.

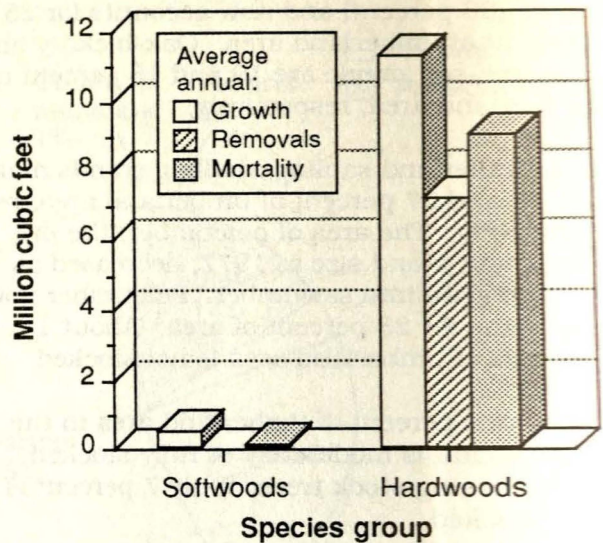


Figure 6.—Average annual growing-stock growth, removals, and mortality on timberland in the Prairie Unit by species group, 1977-1990.

APPENDIX

ACCURACY OF THE SURVEY

Forest Inventory and Analysis information is based on a sampling procedure designed to provide reliable statistics at the State and Survey Unit levels. Consequently, the reported figures are estimates only. A measure of reliability of these figures is given by sampling errors. These sampling errors mean that the chances are two out of three that if a 100-percent inventory had been taken, using the same methods, the results would have been within the limits indicated.

For example, the estimated growing-stock volume in the Unit in 1990, 565.4 million cubic feet, has a sampling error of ± 4.1 percent (± 23.2 million cubic feet). The growing-stock volume from a 100-percent inventory would be expected to fall between 542.2 and 588.6 million cubic feet (565.4 ± 23.2), there being a one in three chance that this is not the case.

The following tabulation shows the sampling errors for the Prairie Forest Inventory:

Item	Unit totals	Sampling error
Growing stock	<i>Million cubic feet</i>	<i>Percent</i>
Volume (1990)	565.4	4.11
Average annual growth (1977-1989)	11.7	9.38
Average annual removals (1977-1989)	7.2	17.10
Sawtimber	<i>Million board feet</i>	
Volume (1990)	1,607.2	5.53
Average annual growth (1977-1989)	41.4	11.83
Average annual removals (1977-1989)	18.7	18.72
Timberland	<i>Thousand acres</i>	
area (1990)	643.8	2.36

NOTE: A standard FIA inventory is designed to provide sampling errors of 3 percent per million acres of timberland or an overall error on Minnesota's nearly 15 million acres of about 0.8 percent. The State of Minnesota funded the collection of additional field data to reduce the sampling error by one-half. The overall goal was to provide a sampling error for total timberland area by county of less than 10 percent.

The sampling error within a county depends on county size and total area of timberland. Many large, heavily forested counties in the State have sampling errors well below ± 5 percent. However, in counties where timberland area is less than 35,000 acres, sampling errors generally exceed ± 10 percent. This is often the case in the Prairie Unit. For this reason we combined data for some counties in this report to provide reporting areas with sampling errors less than ± 10 percent (fig. 7). The sampling error for total timber volume in

a reporting unit containing 35,000 acres of timberland will be about ± 20 percent. Individual county data are provided only in table 1 with the associated sampling error for timberland. Other data for individual counties are available from FIA by special request. However, due to the large sampling errors associated with county-level data, we urge you to use the grouped data when possible.

To estimate the sampling error for values smaller than Unit totals in this report, the following formula is used:

$$E = \frac{(SE) \sqrt{(\text{Unit total area or volume})}}{\sqrt{(\text{Volume or area smaller than Unit total})}}$$

where:

E = sampling error in percent
SE = Unit total error for area or volume

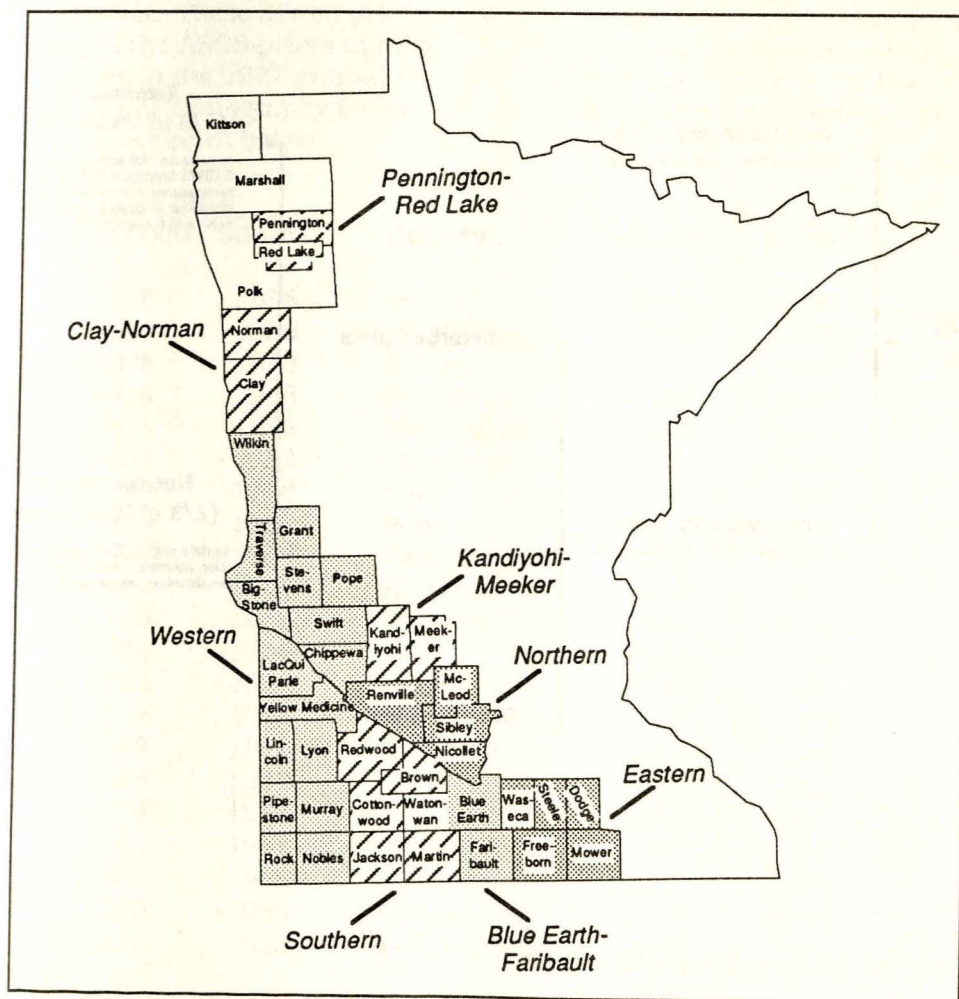


Figure 7.—Counties and grouped county reporting areas for the Prairie Unit, Minnesota.

For example, to compute the error on the area of timberland in the elm-ash-soft maple in the Unit, proceed as follows:

The total area of elm-ash-soft maple type in the Unit from table 3 = 103,000 acres

The total area of all timberland in the Unit from table 3 = 643,800

The Unit total error for timberland area from the above tabulation = 2.36 percent

Using the above formula:

$$\begin{aligned} \text{Error} &= \frac{(2.36) \sqrt{643,800}}{\sqrt{103,000}} \\ &= \pm 5.90 \text{ percent} \end{aligned}$$

SURVEY PROCEDURES

The 1990 Minnesota survey used a growth model enhanced, two-phase sample design. Using this sampling scheme and associated estimators is similar to sampling with partial replacement (SPR), in that a set of randomly located plots is available for remeasurement and a random set of new plots is established and measured. A significant feature of the new Minnesota design is stratification for disturbance on the old sample and use of a growth model to improve regression estimates made on old undisturbed forest plots (fig. 8). Detailed descriptions of the sampling and estimation

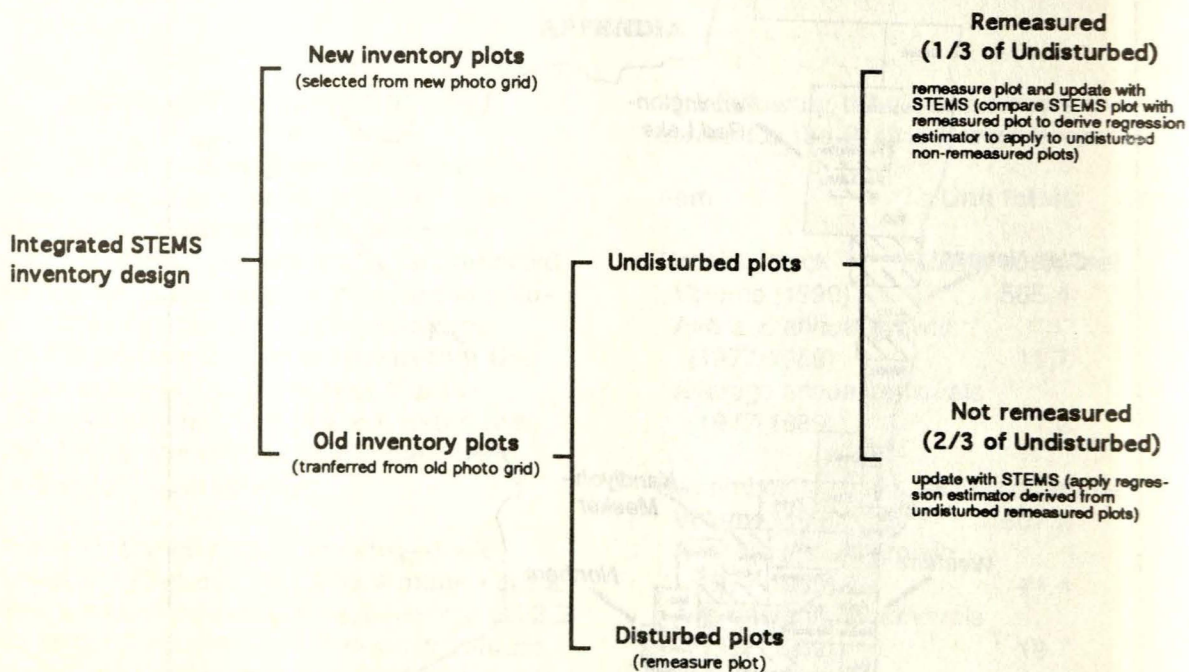


Figure 8.—Overview of the Minnesota sample design.

procedures are presented by Hansen (1990)². The growth model used in the Minnesota survey design was the Lake States Stand and Tree Evaluation and Modeling System (STEMS)³.

These were the major steps in the new survey design:

1. Aerial photography (Phase 1)

In this phase two sets of random points were located on current aerial photography. The first is a set of new photo plots and the second is a set of relocated old ground plot locations from the 1977 inventory. Aerial photos used in the Prairie Unit forest inventory were 1:40,000 scale black and white photos furnished by the Agricultural Stabilization and Conservation Service. In addition, the Minnesota Department of Natural Resources provided 35mm true color prints at a scale of 1:15,840 of all of the 1977 ground plot locations. These 35mm prints were used in addition to the ASCS prints to help detect disturbances in the 1977 ground plot locations. The year of photography for each county in the Unit is shown below.

The locations of the plots used in the 1977 inventory were transferred to these new photographs. The photographs were then assembled into township mosaics, and a systematic grid of 121 one-acre photo plots (each plot representing approximately 190.4 acres) was overlaid on each township mosaic. Each of these photo plots was examined by aerial photogrammetrists and classified stereoscopically based on land use. If trees were present, forest type and stand-size density class were recorded. All of the 1977 ground plot locations were also examined for disturbance (logging, fire, catastrophic mortality, etc.) with the aid of the 35mm photographs.

² Hansen, Mark H. 1990. *A comprehensive sampling system for forest inventory based on an individual tree growth model*. St. Paul, MN: University of Minnesota, College of Natural Resources. 256 p. Ph.D. dissertation.

³ Belcher, David W.; Holdaway, Margaret R.; Brand, Gary J. 1982. *A description of STEMS the stand and tree evaluation and modeling system*. Gen. Tech. Rep. NC-79. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 18 p.

County	Date		County	Date	
	1:40,000	35mm		1:40,000	35mm
Big Stone	1978	1988	Murray	1979	1988
Blue Earth	1980	1988	Nicollet	1978	1988
Brown	1978	1988	Nobles	1979	1988
Chippewa	1978	1988	Norman	1982	1988
Clay	1981	1988	Pennington	1982	1988
Cottonwood	1980	1988	Pipestone	1979	1988
Dodge	1980	1988	Polk	1982	1988
Faribault	1979	1988	Pope	1982	1988
Freeborn	1979	1988	Red Lake	1982	1988
Grant	1982	1988	Redwood	1978	1988
Jackson	1979	1988	Renville	1978	1988
Kandiyohi	1979	1988	Rock	1980	1988
Kittson	1982	1988	Sibley	1980	1988
Lac Qui Parle	1978	1988	Steele	1980	1988
Lincoln	1978	1988	Stevens	1982	1988
Lyon	1978	1988	Swift	1978	1988
Mc Leod	1978	1988	Traverse	1980	1988
Marshall	1982	1988	Waseca	1980	1988
Martin	1980	1988	Watonwan	1980	1988
Meeker	1980	1988	Wilkin	1982	1988
Mower	1979	1988	Yellow Medicine	1978	1988

After this examination, all the old "disturbed" sample locations, a one-third sample of the old "undisturbed" sample locations, and a sample of the new photo plots were sent to the field for survey crews to verify the photo classification and to take further measurements. All photo plot locations for the 1990 inventory were examined for the Prairie Unit and were classified as shown in the following tabulation:

Photo land class	Photo plots
Timberland	12,294
Reserved forest land	326
Other forest land	146
Questionable	480
Nonforest with trees	1,404
Nonforest without trees	48,197
Water	3,285
All classes	66,132

2. Plot measurements (Phase 2)

On plots classified as timberland, wooded pasture, or windbreak (at least 120 feet wide), a ground plot was established, remeasured, or modeled. Old plots sent to the field for remeasurement that could not be relocated were replaced with a new plot at the approximate location of the old one. Each ground plot consists of a 10-point cluster covering approximately 1 acre. At each point, trees 5.0 inches or more in d.b.h. were sampled on a 37.5 Basal Area Factor (BAF) variable-radius plot, and trees less than 5.0 inches d.b.h. were sampled on a 1/300-acre fixed-radius plot. The measurement procedure for the new and old sample locations was as follows:

a. New inventory plots

A random sample of the new photo plots was selected for field measurement. Ground plots were established, and measures of current classification such as land use, forest type, and ownership as well as size and condition of all trees on the plot were recorded. These locations were monumented for future remeasurement.

b. Old inventory plots

These plots were established, monumented, and measured as part of the 1977 field inventory. The procedures for these old plot locations were different from those for the new plots. Old plots were classed as "undisturbed" or "disturbed" in the aerial photo phase of the sampling process. All disturbed plots and a one-third sample of the undisturbed plots were remeasured to obtain estimates of current condition and changes since the last inventory. All trees measured on these plots in 1977 were remeasured or otherwise accounted for, and all new trees were identified and measured.

All sample plots that were forested at the time of the 1977 inventory and determined to be undisturbed until this inventory were projected to the current time using STEMS. This procedure gives projected estimates of current volume and growth for these undisturbed plots. The comparison of the projected and observed values on the one-third sample of the undisturbed forest plots that were remeasured provided local calibration data to adjust the projected values of the undisturbed plots that were not remeasured. The adjustment procedure is a modified version of the method described by Smith⁴.

The old sample plots that were not forested in 1977 and were determined to be undisturbed until the current inventory (no evidence of conversion to another land use) were also subsampled (field checked) at the one-third rate. Any changes in land use to forest detected on these plots were used to adjust the two-thirds sample of these plots not field checked. The field check of these points in the Prairie Unit indicated that no adjustment was necessary.

⁴ Smith, W. Brad. 1983. Adjusting STEMS regional growth models to improve local predictions. Res. Note NC-297. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 5 p.

The undisturbed plots that were not remeasured play a crucial role in the new survey design. These plots, after careful examination comparing past and current aerial photography, were determined to be undisturbed and had conditions that could be simulated by STEMS. The STEMS growth model was used to "grow" the old plot and tree data to produce an estimate of current data. Thus, these plots were treated as ground plots, even though they were never visited. The plot record for each modeled plot was sent to the field for verification of current ownership information.

All old plots classified as disturbed were sent to the field for remeasurement to assess and verify changes since the last inventory. Disturbance refers to any change on a plot that can be detected on aerial photos and that the STEMS growth processor cannot predict, such as catastrophic mortality, cutting, seedling stands, and land use change.

The estimation procedure for computing statistics from this sampling design was more complicated than the simple two-phase estimation procedure used in the past. In fact, this procedure yielded two independent samples, one coming from the new photo points and the other coming from the old photo points that are remeasured or modeled. The following tabulation summarizes the distribution of all ground plots for the new inventory design by type of plot:

Ground land use class	Old plots remeasured	Old plots updated	New plots	Total plots
Timberland	307	116	82	505
Reserved forest land	1	10	—	11
Other forest land	1	1	2	4
Nonforest with trees	87	—	15	102
Nonforest without trees	4,467	8,750	2,357	15,574
Water	90	166	80	336
Total	4,953	9,043	2,536	16,532

3. Area estimates

Area estimates were made using two-phase estimation methods. In this type of estimation, a preliminary estimate of area by land use is made from the aerial photographs (Phase 1) and corrected by the plot measurements (Phase 2). A complete description of this estimation method is presented by Loetsch and Haller (1964)⁵.

4. Volume estimates

Estimates of volume per acre were made from the trees measured or modeled on the 10-point plots. Estimates of volume per acre were multiplied by the area estimates to obtain estimates of total volume. Net cubic foot and board foot volumes are based on the following modification of the method presented by Hahn (1984)⁶ for use in the Lake States. The merchantable height equation was used in conjunction with Stone's equation to estimate gross volume. This estimate was then corrected by species for variation in bark and cull volume to yield an estimate of net volume.

⁵ Loetsch, F.; Haller, K.E. 1964. *Forest inventory, volume 1, Statistics of forest inventory and information from aerial photographs*. BLV Verlagsgesellschaft Munch Basle Vienna. 436 p.

⁶ Hahn, Jerold T. 1984. *Tree volume and biomass equations for the Lake States*. Res. Pap. NC-250. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 10 p.

The Forest Service reports all board foot volume in International 1/4-inch rule. In Minnesota, the Scribner log rule is commonly used. Scribner log rule conversion factors were derived from full tree measurements taken throughout the Lake States (Michigan, Wisconsin, and Minnesota) and an equation developed by Wiant and Castenaeda (1977)⁷. The factors (multipliers) used here to convert board foot International volumes to the Scribner rule are shown in the following tabulation:

D.b.h. (inches)	Scribner rule conversion factor	
	Softwoods	Hardwoods
9.0-10.9	0.7830	—
11.0-12.9	.8287	0.8317
13.0-14.9	.8577	.8611
15.0-16.9	.8784	.8827
17.0-18.9	.8945	.8999
19.0-20.9	.9079	.9132
21.0-22.9	.9168	.9239
23.0-24.9	.9240	.9325
25.0-26.9	.9299	.9396
27.0-28.9	.9321	.9454
29.0+	.9357	.9544

5. Growth and mortality estimates

On remeasured plots, estimates of growth and mortality per acre come from the remeasured diameters of trees and from observation of trees that died between inventories. Growth, reported as the average net annual growth between the two inventories (1977 and 1990), is computed from data on remeasurement plots and modeled plots using methods presented by VanDeusen et al. (1986)⁸. Mortality is also average net annual for the remeasurement period. On new plots, where trees were not remeasured, estimates of growth and mortality were obtained by using

STEMS to project the growth and mortality of trees for 1 year. Growth and mortality estimates for old undisturbed plots that were updated were derived in the same manner as those for remeasured plots. The STEMS growth model was adjusted by Survey Unit to meet local conditions, using data from the undisturbed remeasurement plots. As with volume, total growth and mortality estimates were obtained by multiplying the per acre estimates by area estimates. Current annual growth for 1989 was computed by using the adjusted STEMS model to grow all current inventory plots for 1 year.

6. Average annual removals estimates

Average annual growing-stock and sawtimber removals (1977 to 1989) were estimated only from the remeasured plots; new plots were not used to estimate removals. These estimates are obtained from trees measured in the last survey and cut or otherwise removed from the timberland base. Because remeasurement plots make up about one-half of the total ground plots, average annual removals estimates have greater sampling errors than volume and growth estimates.

COMPARING MINNESOTA'S FIFTH INVENTORY WITH THE FOURTH INVENTORY

The following paragraphs highlight some of the procedural changes since the last inventory to assist the reader in analyzing data from this report:

A new volume estimation procedure was developed for the Lake States (see Survey Procedures section), and this procedure was used to compute the 1989 volumes and to recompute the 1977 volume for growth calculations. Although the adjustment will differ by Survey Unit and species, the recomputed 1977 growing-stock and board foot volumes will generally be greater than those shown in the 1977 report.

⁷ Wiant, Harry V., Jr.; Castenaeda, Froylan. 1977. *Mesavage and Girard's volume tables formulated*. BLM4. Denver, CO: U.S. Department of Interior, Bureau of Land Management, Denver Service Center: 1-4.

⁸ VanDeusen, P.C.; Dell, T.R.; Thomas, C.E. 1986. *Volume growth estimation from permanent horizontal points*. *Forest Science*. 32: 415-422.

Past surveys used only growing-stock trees to determine stand-size class. Current survey procedures require that stand-size class be determined on the basis of all live trees. Therefore, direct comparisons of current inventory data to old inventory data by stand-size class may be misleading.

The basic building block for estimating forest area and timber volume has been changed from the Survey Unit to the county.⁹ In the past, the statistics were developed at the Unit level and prorated back to the county on the basis of photo-interpretation plots. Direct development of county-level data helps users interested in more precise local data, but can make the outcome of comparisons with past estimates uncertain.

TREE GRADE

On approximately one-third of the sample plots in the Prairie and Central Hardwood Units of Minnesota, all sawtimber sample trees were graded for quality and assigned a tree grade. Tree grades are based on the classification of external characteristics as indicators of quality. The volume yield by tree grade for this sample was used to distribute the volume of the ungraded sample trees by species group.

Hardwood sawtimber trees were graded according to "Hardwood tree grades for factory lumber".¹⁰ The best 12-foot section of the lowest 16-foot hardwood log, or the best 12-foot upper section if the butt log did not meet minimum log-grade standards, was used for grading. Hardwood sawtimber trees that did not meet minimum tree grade specifications for grades 1 through 3 were assigned grade 4 according to Forest Service standard specifications for hardwood construction logs described in "A guide to hardwood log grading."¹¹

Red pine and jack pine sawtimber trees were graded based on specifications described in "Forest Service log grades for southern pines."¹² White pine and other softwood sawtimber trees were graded according to specifications described in the circular "Log grades"¹³ from the University of Wisconsin. For all softwoods, the first merchantable 16-foot log or shorter lengths down to 12 feet were used for grading.

⁹ Counties where timberland area is small (less than 35,000 acres) have been grouped to provide reporting areas with sampling errors lower than ± 10 percent.

¹⁰ Hanks, Leland F. 1976. Hardwood tree grades for factory lumber. Res. Pap. NE-333. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 81 p.

¹¹ Rast, Everette D.; Sonderman, David L.; Gammon, Glenn L. 1973. A guide to hardwood log grading. Gen. Tech. Rep. NE-1. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 31 p.

¹² Campbell, Robert A. 1964. Forest Service log grades for southern pine. Res. Pap. SE-11. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 17 p.

¹³ Peterson, Ted. 1965. Log grades. Spec. Circ. 60. Madison, WI: University of Wisconsin, Extension Service, College of Agriculture. 4 p.

Hardwood Tree Grades for Factory Lumber

Grade factor	Tree grade 1	Tree grade 2	Tree grade 3
Length of grading zone (feet)	Butt 16	Butt 16	Butt 16
Length of grading section ^a (feet)	Best 12	Best 12	Best 12
D.b.h., minimum (inches)	16 ^b	13	11
Diameter, minimum inside bark at top of grading section (inches)	13 ^b 16 20	11 ^c 12	8
Clear cuttings (on the three best faces) ^d			
Length, minimum (feet)	7 5 3	3 3	2
Number on face (maximum)	2	2 3	e
Yield in face length (minimum)	5/6	4/6	3/6
Cull deduction (including crook and sweep, but excluding shake) maximum within grading section (percent)	9	9 ^f	50

^a Whenever a 14- or 16-foot section of the butt 16-foot log is better than the best 12-foot section, the grade of the longer section will become the grade of the tree. This longer section, when used, is the basis for determining the grading factors such as diameter and cull deduction.

^b In basswood and ash, d.i.b. at top of grading section must be 12 inches and d.b.h. must be 15 inches.

^c Grade 2 trees can be 10 inches d.i.b. at top of grading section if otherwise meeting surface requirements for small grade 1's.

^d A clear cutting is a portion of a face free of defects, extending the width of the face. A face is one-fourth of the surface of the grading section as divided lengthwise.

^e Unlimited.

^f Fifteen percent crook and sweep or 40 percent total cull deduction are permitted in grade 2, if size and surface of grading section qualify as grade 1. If rot shortens the required clear cuttings to the extent of dropping the butt log to grade 2, do not drop the tree's grade to 3 unless the cull deduction for rot is greater than 40 percent.

Forest Service Standard Specifications for Hardwood Construction Logs (tie and timber logs)¹

Position in tree	Butts and uppers
Min. diameter, small end	8 inches +
Min. length without trim	8 feet
Clear cuttings	No requirements
Sweep allowance	One-fourth of the diameter at the small end for each 8 feet of length.
Sound surface defects:	
Single knots	Any number, if no one knot has an average diameter above the callus in excess of one-third of the log diameter at point of occurrence.
Whorled knots	Any number, if the sum of knot diameters above the callus does not exceed one-third of the log diameter at point of occurrence.
Holes	Any number, provided none has a diameter over one-third of the log diameter at point of occurrence and none extends more than 3 inches into included timber ² .
Unsound surface defects :	Same requirements as for sound defects if they extend into included timber. No limit if they do not.

¹These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only nonfactory logs from which to select construction logs, then the quality range of the construction logs so selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, it may be necessary to subdivide the class into grades.

²Included timber is always square, and dimension is judged from small end.

Tree Grades for Eastern White Pine

Log grade	Minimum size ¹		Sweep or crook allowance	Total cull allowance including sweep	Maximum weevil injury	Allowable knot size (inches) ² on three best faces or minimum clearness on four faces
	(Inches)	(Feet)	(Percent)	(Percent)	(Number)	(Inches)
1	12 & 13	8-16	20	50	0	Four faces clear full length
	14+	10-16	20	50	0	Two faces clear full length, or four faces clear 50 percent length (6 feet min. length) ³
2	6+	8-16	30	50	0	Sound knots i.e. ⁴ D/6 and less than 3 inches ⁵ Unsound knots: i.e. 1-1/2 inches and for: butt, logs i.e. D/12 upper logs i.e. D/10, or four faces clear 50 percent of length
3	6+	8-16	40	50	8-foot logs: 1 weevil	Sound knots i.e. D/3 and less than 5 inches
					10-foot+ logs: 2 weevils	Unsound knots i.e. D/6 and less than 2-1/2 inches
4	6+	8-16	50	50	No limit	No limit

¹Plus trim.

²Disregard all knots less than 1/2-inch diameter in all grades.

³The sum of the diameter of sound knots plus twice the sum of the diameter of unsound knots (in inches) is less than or equal to half of the diameter of the log (inches).

⁴i.e. means less than or equal to.

⁵D means d.i.b. of log at location of knot.

TREE GRADES FOR JACK PINE AND RED PINE

Grade 1: Trees with three or four clear faces on the 16-foot grading section.¹

Grade 2: Trees with one or two clear faces on the 16-foot grading section.

Grade 3: Trees with no clear faces on the 16-foot grading section.

After the tentative grade is established from above, the tree will be reduced one grade for each of the following, except that no tree can be reduced below grade 3, provided the total scaling deductions for sweep and/or rot do not exceed two-thirds of the gross scale of the tree.

1. *Sweep.* Degrade any tentative grade 1 or 2 tree one grade if sweep in the lower 12 feet of grading sections amounts to 3 or more inches and equals or exceeds one-fourth of the diameter at breast height.

2. *Heart rot.* Degrade any tentative grade 1 or 2 tree one grade if conk, punk knots, massed hyphae, or other evidence of advanced heart rot is found anywhere on the main tree stem.

¹A face is one-fourth of the circumference in width extending the full length of the grading section. Clear faces are those free of: knots measuring more than 1/2-inch in diameter, overgrown knots of any size, and holes more than 1/4-inch in diameter. Faces may be rotated to obtain the maximum number of clear on the grading section.

TREE GRADES FOR ALL OTHER SOFTWOOD LOGS

Grade 1

1. Trees must be 16 inches in diameter^A or larger, grading section 12 feet in length or longer, and with deduction for defect not over 30 percent of gross scale.
2. Trees must be at least 75 percent clear^B on each of three faces.
3. All knots outside clear cutting must be sound and not more than 2-1/2 inches in size.

Grade 2

1. Trees must be 12 inches in diameter or larger, grading section 12 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross scale deducted for defect.
2. Trees must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade 3

1. Trees must be 6 inches in diameter or larger, grading section 12 feet in length or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.
-

Note: A) Diameters are diameter inside bark (d.i.b.) at small end of grading section.

B) Percent clear refers to percent clear in one continuous section.

METRIC EQUIVALENTS OF UNITS USED IN THIS REPORT

- 1 acre = 4,046.86 square meters or 0.405 hectare.
 1,000 acres = 405 hectares.
 1 cubic foot = 0.0283 cubic meter.
 1 foot = 30.48 centimeters or 0.3048 meter.
 1 inch = 25.4 millimeters, 2.54 centimeters, or 0.0254 meter.
 1 pound = 0.454 kilograms.
 1 ton = 0.907 metric tons.

TREE SPECIES GROUPS IN MINNESOTA¹⁴

SOFTWOODS

- Eastern white pine *Pinus strobus*
 Red pine *Pinus resinosa*
 Jack pine *Pinus banksiana*
 White spruce *Picea glauca*
 Black spruce *Picea mariana*
 Balsam fir *Abies balsamea*
 Tamarack *Larix laricina*
 Northern white-cedar *Thuja occidentalis*
 Other softwoods:
 Eastern redcedar *Juniperus virginiana*
 Scotch pine *Pinus sylvestris*

HARDWOODS

- Select white oak¹⁵
 White oak *Quercus alba*
 Bur oak *Quercus macrocarpa*
 Select red oak¹⁵
 Northern red oak *Quercus rubra*
 Other red oak¹⁵
 Northern pin oak *Quercus ellipsoidalis*
 Black oak *Quercus velutina*
 Hickory¹⁵
 Shagbark hickory *Carya ovata*
 Bitternut hickory *Carya cordiformis*

¹⁴ The common and scientific names are based on: Little, Elbert L. 1981. Checklist of native and naturalized trees of the United States. Agric. Handb. 541. Washington, DC: U.S. Department of Agriculture, Forest Service. 385 p.

¹⁵ This species or species group is considered a hard hardwood, with an average specific gravity greater than or equal to 0.50.

- Basswood¹⁶ *Tilia americana*
 Yellow birch¹⁶ *Betula alleghaniensis*
 Hard maple¹⁵
 Black maple *Acer nigrum*
 Sugar maple *Acer saccharum*
 Soft maple¹⁶
 Red maple *Acer rubrum*
 Silver maple *Acer saccharinum*
 Elm
 American elm¹⁶ *Ulmus americana*
 Slippery elm¹⁶ *Ulmus rubra*
 Rock elm¹⁵ *Ulmus thomasi*
 Ash¹⁵
 White ash *Fraxinus americana*
 Black ash *Fraxinus nigra*
 Green ash *Fraxinus pennsylvanica*
 Cottonwood¹⁶ *Populus deltoides*
 Black willow¹⁶ *Salix nigra*
 Hackberry¹⁶ *Celtis occidentalis*
 Balsam poplar¹⁶ *Populus balsamifera*
 Aspen¹⁶
 Bigtooth aspen *Populus grandidentata*
 Quaking aspen *Populus tremuloides*
 Paper birch¹⁵ *Betula papyrifera*
 Black cherry¹⁶ *Prunus serotina*
 Black walnut¹⁵ *Juglans nigra*
 Butternut¹⁶ *Juglans cinerea*
 Other hardwoods
 Boxelder¹⁶ *Acer negundo*
 Black locust¹⁵ *Robinia pseudoacacia*
 Red mulberry¹⁶ *Morus rubra*
 Honeylocust¹⁵ *Gleditsia triacanthos*
 Northern catalpa¹⁵ *Catalpa speciosa*
 Noncommercial species
 Eastern hophornbeam *Ostrya virginiana*
 Apple *Malus* spp.
 American hornbeam *Carpinus caroliniana*
 Wild plum *Prunus* spp.
 Hawthorn *Crataegus* spp.

¹⁶ This species or species group is considered a soft hardwood, with an average specific gravity of less than 0.50.

DEFINITION OF TERMS

Average annual removals from growing

stock.—The average net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses (see Other removals). Average annual removals of growing stock are reported for a period of several years (1977 to 1989 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Average annual removals from sawtimber.

The average net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses [see Other removals]). Average annual removals of sawtimber are reported for a period of several years (1977 to 1989 in this report) and are based on information obtained from remeasurement plots (see Survey Procedures in Appendix).

Commercial species.—Tree species presently or prospectively suitable for industrial wood products. (Note: Excludes species of typically small size, poor form, or inferior quality such as hophornbeam, Osage-orange, and redbud.)

Commercial forest land.—(See Timberland).

Cord.— One standard cord is 128 cubic feet of stacked wood, including bark and air space. Cubic feet can be converted to standard cords by dividing by 79.

County and municipal land.—Land owned by counties and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

Cull.—Portions of a tree that are unusable for industrial wood products because of rot, missing or dead material, or other defect.

Current annual growth of growing stock.

The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes. Current growth is based on an estimate of the current annual increment of each growing-stock tree in the inventory.

Current annual growth of sawtimber.—The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes. Current growth is based on an estimate of the current annual increment of each growing-stock tree in the inventory.

Current annual removals from growing

stock.—The current net growing-stock volume in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other uses (see Other removals). Current annual removals of growing stock are reported for a single year (1988 in this report) and are based on a survey of primary wood processing mills to determine removals for products and on information from remeasurement plots (see Survey Procedures in Appendix) to determine removals due to land use change.

Current annual removals from sawtimber.

The current net board foot sawtimber volume of live sawtimber trees removed annually for forest products (including roundwood products and other uses [see Other removals]). Current annual removals of sawtimber are reported for a single year (1988 in this report) and are based on a survey of primary wood processing mills to determine removals for products and on information from remeasurement plots (see Survey Procedures in Appendix) to determine removals due to land use change.

Diameter class.—A classification of trees based on diameter outside bark, measured at breast height (d.b.h.). Two-inch diameter classes are commonly used in Forest Inventory and Analysis, with the even inch the approximate midpoint for a class. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Diameter at breast height (d.b.h.).—The outside bark diameter at 4.5 feet (1.37 m) above the forest floor on the uphill side of the tree. For determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

Farm.—Any place from which \$1,000 or more of agricultural products were produced and sold during the year.

Farmer-owned land.—Land owned by farm operators whether part of the farmstead or not. (Note: Excludes land leased by farm operators from nonfarm owners, such as railroad companies and States.)

Forest land.—Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. (Note: Stocking is measured by comparing specified standards with basal area and/or number of trees, age or size, and spacing.) The minimum area for classification of forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, or other bodies of water or clearings in forest areas shall be classed as forest if less than 120 feet wide. (See Tree, Land, Timberland, Reserved forest land, Other forest land, Stocking, and Water.)

Forest industry land.—Land owned by companies or individuals that operate a primary wood-using plant.

Forest type.—A classification of forest land based on the species forming a plurality of live tree stocking. Major forest types in the State are:

Jack pine.—Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)

Red pine.—Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.)

White pine.—Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch, and maple.)

Balsam fir.—Forests in which balsam fir and white spruce comprise a plurality of stocking with balsam fir the most common. (Common associates include aspen, maple, birch, northern white-cedar, and tamarack.)

White spruce.—Forests in which white spruce and balsam fir comprise a plurality of the stocking with white spruce the most common. (Common associates include aspen, maple, birch, northern white-cedar, and tamarack.)

Black spruce.—Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. (Common associates include tamarack and northern white-cedar.)

Northern white-cedar.—Forests in which swamp conifers comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.)

Tamarack.—Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. (Common associates include black spruce and northern white-cedar.)

Oak-hickory.—Forests in which northern red oak, white oak, bur oak, or hickories, singly or in combination, comprise a plurality of the stocking. (Common associates include jack pine, elm, and maple.)

Elm-ash-soft maple.—Forests in which lowland elm, ash, red maple, silver maple, and cottonwood, singly or in combination, comprise a plurality of the stocking. (Common

associates include birches, spruce, and balsam fir.)

Maple-basswood.—Forests in which sugar maple, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include white pine, elm, and basswood.)

Aspen.—Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.)

Paper birch.—Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.)

Balsam poplar.—Forests in which balsam poplar comprises a plurality of the stocking. (Common associates include aspen, elm, and ash.)

Growing-stock tree.—A live tree of commercial species that meets specified standards of size, quality, and merchantability. (Note: Excludes rough, rotten, and dead trees.)

Growing-stock volume.—Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from 1 foot above the ground to a minimum 4.0 inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs.

Hard hardwoods.—Hardwood species with an average specific gravity greater than 0.50 such as oaks, hard maple, hickories, and ash.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous. (See Soft hardwoods and Hard hardwoods.)

Indian land.—Land held in trust by the United States for the tribes or individual Indians.

Land.—A. *Bureau of the Census.* Dry land and land temporarily or partly covered by water such as marshes, swamps, and river flood plains (omitting tidal flats below mean high tide); streams, sloughs, estuaries, and canals less than one-eighth of a statute mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

B. *Forest Inventory and Analysis.* The same as the Bureau of the Census, except minimum width of streams, etc., is 120 feet and minimum size of lakes, etc., is 1 acre.

Marsh.—Nonforest land that characteristically supports low, generally herbaceous or shrubby vegetation and that is intermittently covered with water.

Merchantable.—Refers to a pulpwood or saw-log section that meets pulpwood or saw-log specifications, respectively.

Miscellaneous Federal land.—Federal land other than National Forest and land administered by the Bureau of Land Management or Bureau of Indian Affairs.

Miscellaneous private land.—Privately owned land other than forest-industry and farmer-owned land.

Mortality.—The volume of sound wood in growing-stock and sawtimber trees that die annually.

National Forest land.—Federal land that has been legally designated as National Forest or purchase units, and other land administered by the USDA Forest Service.

Net annual growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes.

Net annual growth of sawtimber.—The annual change in the volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes.

Net volume.—Gross volume less deductions for rot, sweep, or other defect affecting use for timber products.

Noncommercial species.—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

Nonforest land.—Land that has never supported forests, and land formerly forested where use for timber management is precluded by development for other uses. (Note: Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and nonforest strips must be more than 120 feet wide and more than 1 acre in area to qualify as nonforest land.)

a. *Nonforest land without trees.*—Nonforest land with no live trees present.

b. *Nonforest land with trees.*—Nonforest land with one or more trees per acre at least 5 inches d.b.h.

Nonstocked land.—Forest land less than 16.7 percent stocked with all live trees.

Other forest land.—Forest land not capable of producing 20 cubic feet per acre per year of industrial wood crops under natural conditions and not associated with urban or rural development. These sites often contain tree species that are not currently utilized for industrial wood production or trees of poor form, small size, or inferior quality that are unfit for industrial products. Low productivity may be the result of adverse site conditions such as sterile soil, dry climate, poor drainage, high elevation, and rockiness. This land is not withdrawn from timber utilization.

Other removals.—Growing-stock trees removed but not utilized for products, or trees left standing but “removed” from the timberland classification by land use change. Examples are removals from cultural operations such as timber stand improvement work, land clearing, and changes in land use.

Poletimber stand.—(See Stand-size class.)

Poletimber tree.—A tree of commercial species at least 5.0 inches d.b.h. but smaller than sawtimber size.

Potential productivity class.—A classification of forest lands in terms of inherent capacity to grow crops of industrial wood. The class identifies the potential growth in merchantable cubic feet/acre/year at culmination of mean annual increment of fully stocked natural stands.

Reserved forest land.—Forest land withdrawn from timber utilization through statute, administrative regulation, designation, or exclusive use for Christmas tree production, as indicated by annual shearing.

Rotten tree.—A tree that does not meet regional merchantability standards because of excessive unsound cull. May include noncommercial tree species.

Rough tree.—A tree that does not meet regional merchantability standards because of excessive sound cull. May include noncommercial tree species.

Salvable dead tree.—A standing or down dead tree considered merchantable by regional standards.

Sapling.—A live tree 1.0 to 5.0 inches d.b.h.

Sapling-seedling stand.—(See Stand-size class.)

Saw log.—A log meeting minimum standards of diameter, length, and defect, including logs at least 8 feet long, sound and straight and with a minimum diameter outside bark (d.o.b.) for softwoods of 7.0 inches (9.0 inches for hardwoods) or other combinations of size and defect specified by regional standards.

Saw-log portion.—That part of the bole of sawtimber trees between the stump and the saw-log top.

Saw-log top.—The point on the bole of sawtimber trees above which a saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods.

Sawtimber stand.—(See Stand-size class.)

Sawtimber tree.—A tree of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs 8 feet or longer, and meeting regional specifications for freedom from defect. Softwoods must be at least 9.0 inches d.b.h. Hardwoods must be at least 11.0 inches d.b.h.

Sawtimber volume.—Net volume of the saw-log portion of live sawtimber in board feet, International 1/4-inch rule (unless specified otherwise) from stump to a minimum 7 inches top diameter outside bark (d.o.b.) for softwoods and a minimum 9 inches top d.o.b. for hardwoods.

Seedling.—A live tree less than 1.0 inch d.b.h. that is expected to survive. Only softwood seedlings more than 6 inches tall and hardwood seedlings more than 1 foot tall are counted.

Short-log (rough tree).—Sawtimber-size trees of commercial species that contain at least one merchantable 8- to 11-foot saw log but not a 12-foot saw log.

Site index.—An expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at age 50.

Soft hardwoods.—Hardwood species with an average specific gravity less than 0.50 such as gum, yellow-poplar, cottonwood, red maple, basswood, and willow.

Softwoods.—Coniferous trees, usually evergreen, having needles or scale-like leaves.

Stand.—A group of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Stand-size class.—A classification of stocked (see Stocking) forest land based on the size class of live trees on the area; that is, sawtimber, poletimber, or seedlings and saplings.

a. Sawtimber stands.—Stands with half or more of live stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

b. Poletimber stands.—Stands with half or more live stocking in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

c. Sapling-seedling stands.—Stands with more than half of the live stocking in saplings and/or seedlings.

State land.—Land owned by States or leased to them for 50 years or more.

Stocking.—The degree of occupancy of land by live trees, measured by basal area and/or the number of trees in a stand by size or age and spacing, compared to the basal area and/or number of trees required to fully utilize the growth potential of the land; that is, the stocking standard.

A stocking percent of 100 indicates full utilization of the site and is equivalent to 80 square feet of basal area per acre in trees 5.0 inches d.b.h. and larger. In a stand of trees less than 5 inches d.b.h., a stocking percent of 100 would indicate that the present number of trees is sufficient to produce 80 square feet of basal area per acre when the trees reach 5 inches d.b.h.

Stands are grouped into the following stocking classes:

Overstocked stands.—Stands in which stocking of live trees is 133 percent or more.

Fully stocked stands.—Stands in which stocking of live trees is from 100.0 to 132.9 percent.

Moderately stocked stands.—Stands in which stocking of live trees is from 60.0 to 99.9 percent.

Poorly stocked stands.—Stands in which stocking of live trees is from 16.7 to 59.9 percent.

Nonstocked areas.—Timberland on which stocking of live trees is less than 16.7 percent.

Timberland.—Forest land that is producing or capable of producing in excess of 20 cubic feet per acre per year of industrial wood crops under natural conditions, that is not withdrawn from timber utilization, and that is not associated with urban or rural development. Currently inaccessible and inoperable areas are included.

Tree.—A woody plant usually having one or more perennial stems, a more or less definitely formed crown of foliage, and a height of at least 12 feet at maturity.

Tree grade.—A tree classification based on external characteristics of the butt log as an indicator of quality or value. Tree grades may be converted to lumber grade yields for individual species. (See Appendix for specific grading factors used.)

Tree size class.—A classification of trees based on diameter at breast height, including sawtimber trees, poletimber trees, saplings, and seedlings.

Upper stem portion.—That part of the bole of sawtimber trees above the saw log top to a minimum top diameter of 4.0 inches outside bark or to the point where the central stem breaks into limbs.

Water.—A. *Bureau of the Census.*—Permanent inland water surfaces, such as lakes, reservoirs, and ponds at least 40 acres in area; and streams, sloughs, estuaries, and canals at least one-eighth of a statute mile wide.

B. *Noncensus.*—Permanent inland water surfaces, such as lakes, reservoirs, and ponds from 1 to 39.9 acres in area; and streams, sloughs, estuaries, and canals from 120 feet to one-eighth of a statute mile wide.

Wooded strip.—An acre or more of natural continuous forest land that would otherwise meet survey standards for timberland except that it is less than 120 feet wide.

Tables

Table 1.—Area of land by county and major land-use class, Prairie Unit, Minnesota, 1990

Table 2.—Area of timberland by county and ownership class, Prairie Unit, Minnesota, 1990

Table 3.—Area of timberland by county and forest type, Prairie Unit, Minnesota, 1990

Table 4.—Area of timberland by county and stand-size class, Prairie Unit, Minnesota, 1990

Table 5.—Area of timberland by county and potential productivity class, Prairie Unit, Minnesota, 1990

Table 6.—Area of timberland by county and stocking class of growing-stock trees, Prairie Unit, Minnesota, 1990

Table 7.—Area of timberland by ownership class and stocking class of growing-stock trees, Prairie Unit, Minnesota, 1990

Table 8.—Area of timberland by forest type and ownership class, Prairie Unit, Minnesota, 1990

Table 9.—Area of timberland by forest type and stand-size class, Prairie Unit, Minnesota, 1990

Table 10.—Number of all live trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

Table 11.—Number of growing-stock trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

Table 12.—Net volume of timber on timberland by class of timber and species group, Prairie Unit, Minnesota, 1990

Table 13.—Net volume of growing-stock trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

Table 14.—Net volume of growing stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

Table 15.—Net volume of sawtimber trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

Table 16.—Net volume of growing stock and sawtimber on timberland by county and species group, Prairie Unit, Minnesota, 1990

Table 17.—Net volume of live trees and growing stock on timberland by ownership class and species group, Prairie Unit, Minnesota, 1990

Table 18.—Net volume of sawtimber trees on timberland by species group and butt log grade, Prairie Unit, Minnesota, 1990

Table 19.—Average net annual growth of growing stock and sawtimber on timberland by county and species group, Prairie Unit, Minnesota, 1977-1989

Table 20.—Average annual removals of growing stock and sawtimber on timberland by county and species group, Prairie Unit, Minnesota, 1977-1989

Table 21.—Average net annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Prairie Unit, Minnesota, 1977-1989

Table 22.—Average net annual growth and average annual removals of growing stock on timberland by ownership class and species group, Prairie Unit, Minnesota, 1977-1989

Table 23.—Average net annual growth and average annual removals of sawtimber on timberland by ownership class and species group, Prairie Unit, Minnesota, 1977-1989

Table 24.—Current annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Prairie Unit, Minnesota, 1989

Table 1.--Area of land by county and major land-use class, Prairie Unit, Minnesota, 1990

(In thousand acres)

County and county group	Land area	Forest land					Sampling error for timberland (SE)
		All forest land	Timberland	Timberland as a percent of land area	Other forest land	Reserved forest land	
		Thousand acres	Thousand acres	Percent	Thousand acres	Thousand acres	
Kittson	706.6	56.2	54.0	7.6	0.8	1.3	8.1
Marshall	1,127.4	143.2	138.7	12.3	4.2	0.2	5.1
Polk	1,267.1	55.9	55.7	4.4	0.2	--	8.0
Blue Earth	479.4	26.2	25.5	5.3	0.1	0.6	11.9
Faribault	452.0	6.8	6.5	1.4	0.3	--	23.5
Blue Earth-Faribault total	931.4	33.0	32.0	3.4	0.4	0.6	10.6
Clay	669.3	13.4	12.9	1.9	0.3	0.2	16.7
Norman	557.2	25.7	25.5	4.6	0.2	--	11.9
Clay-Norman total	1,226.5	39.1	38.5	3.1	0.5	0.2	9.7
Dodge	281.3	8.9	8.8	3.1	--	--	20.2
Freeborn	447.2	4.2	4.2	0.9	--	--	29.2
Mower	457.4	3.4	3.0	0.7	--	0.4	34.6
Steele	274.7	9.0	8.7	3.2	0.1	0.2	20.3
Waseca	270.2	10.1	10.0	3.7	0.1	--	18.9
Eastern group total	1,730.8	35.6	34.7	2.0	0.2	0.6	10.2
Kandiyohi	504.7	28.0	26.4	5.2	0.1	1.5	11.7
Meeker	394.1	13.8	13.5	3.4	0.3	--	16.3
Kandiyohi-Meeker total	898.8	41.8	39.9	4.4	0.4	1.5	9.5
McLeod	318.3	8.8	8.7	2.7	0.1	--	20.3
Nicollet	283.5	22.0	21.4	7.5	--	0.6	12.9
Renville	633.8	16.0	15.9	2.5	0.2	--	15.0
Sibley	379.7	22.2	21.7	5.7	0.1	0.4	12.9
Northern group total	1,615.3	69.0	67.7	4.2	0.4	1.0	7.3
Pennington	389.1	33.6	33.5	8.6	0.1	--	10.3
Red Lake	276.7	26.4	26.4	9.5	0.1	--	11.7
Pennington-Red Lake total	665.8	60.0	59.9	9.0	0.2	--	7.7
Brown	385.4	15.6	14.9	3.9	0.1	0.6	15.5
Cottonwood	404.8	4.2	4.1	1.0	0.1	--	29.6
Jackson	448.7	3.8	3.6	0.8	0.1	0.2	31.6
Martin	450.1	3.0	3.0	0.7	0.1	--	34.6
Redwood	564.0	9.8	9.7	1.7	0.1	--	19.2
Watonwan	278.9	5.6	5.6	2.0	--	--	25.3
Southern group total	2,531.9	42.0	40.9	1.6	0.5	0.8	9.4
Big Stone	323.7	2.1	2.0	0.6	0.1	--	42.3
Chippewa	377.3	7.3	7.2	1.9	0.1	--	22.3
Grant	344.1	4.7	4.6	1.3	0.1	--	27.9
Lac Qui Parle	491.1	9.0	8.3	1.7	0.2	0.4	20.8
Lincoln	338.5	2.8	2.8	0.8	--	--	35.8
Lyon	457.2	10.0	9.3	2.0	0.1	0.6	19.6
Murray	449.0	4.9	4.2	0.9	0.1	0.6	29.2
Nobles	458.9	0.5	0.5	0.1	--	--	84.7
Pipestone	303.4	0.6	0.6	0.2	--	--	77.3
Pope	423.5	18.7	18.6	4.4	0.1	--	13.9
Rock	308.1	1.7	1.6	0.5	0.1	--	47.3
Stevens	356.5	4.1	4.0	1.1	0.1	--	29.9
Swift	477.2	5.3	5.3	1.1	0.1	--	26.0
Traverse	369.6	2.1	2.0	0.5	0.1	--	42.3
Wilkin	479.9	3.4	3.4	0.7	0.1	--	32.5
Yellow Medicine	482.4	7.4	7.4	1.5	--	--	22.0
Western group total	6,440.4	84.6	81.8	1.3	1.3	1.5	6.6
All counties	19,142.1	660.4	643.8	3.4	9.1	7.6	2.4

Table 2.--Area of timberland by county and ownership class, Prairie Unit, Minnesota, 1990

(In thousand acres)

County or group	All owners	Ownership class					
		Misc. federal	State	County & municipal	Farmer	Misc. private corporation	Misc. private individual
Blue Earth-Faribault	32.0	0.4	1.2	0.7	20.7	1.1	7.9
Clay-Norman	38.5	0.9	3.4	0.6	23.6	1.5	8.5
Eastern group	34.7	0.3	2.3	0.2	22.2	1.0	8.7
Kandiyohi-Meeker	39.9	0.5	2.6	0.3	25.6	1.3	9.6
Kittson	54.0	1.6	9.9	0.6	27.8	1.9	12.2
Marshall	138.7	4.4	30.8	0.7	66.0	4.1	32.7
Northern group	67.7	0.7	3.4	0.8	43.7	1.9	17.2
Pennington-Red Lake	59.9	1.7	10.2	0.7	31.6	1.8	13.9
Polk	55.7	1.4	7.8	0.9	30.6	1.7	13.3
Southern group	40.9	0.6	2.3	0.4	26.6	1.4	9.6
Western group	81.8	1.3	4.0	1.1	53.3	3.2	18.9
All counties	643.8	13.8	77.9	7.0	371.7	20.9	152.5

Table 3.--Area of timberland by county and forest type, Prairie Unit, Minnesota, 1990

(In thousand acres)

County or county group	All types	Forest type									
		Red pine	White pine	Black spruce	Tamarack	Oak-hickory	Elm-ash-soft-maple	Maple-bass-wood	Aspen	Balsam poplar	Non-stocked
Blue Earth-Faribault	32.0	--	--	--	0.2	8.3	8.1	11.8	3.1	0.1	0.4
Clay-Norman	38.5	--	0.1	0.1	--	6.5	8.2	11.3	10.3	1.3	0.7
Eastern group	34.7	--	0.1	0.1	--	13.0	5.5	13.0	2.5	0.2	0.3
Kandiyohi-Meeker	39.9	--	0.1	0.1	--	12.8	7.0	14.8	4.3	0.4	0.4
Kittson	54.0	0.2	0.1	0.3	0.7	5.6	6.9	7.7	28.1	3.8	0.6
Marshall	138.7	0.5	0.2	0.6	3.7	13.0	10.6	9.3	87.0	12.6	1.2
Northern group	67.7	--	0.1	0.1	--	18.5	13.0	29.1	5.8	0.4	0.7
Pennington-Red Lake	59.9	0.2	0.1	0.3	0.2	7.3	7.2	9.4	30.4	4.3	0.5
Polk	55.7	0.2	--	0.2	0.2	6.1	8.8	11.2	25.1	3.4	0.5
Southern group	40.9	--	0.1	0.1	--	11.7	8.4	15.4	4.3	0.4	0.5
Western group	81.8	--	0.1	0.1	0.2	20.0	19.3	28.9	11.0	1.0	1.2
All counties	643.8	1.1	1.0	2.0	5.2	122.8	103.0	161.9	211.9	27.9	7.0

Table 4.--Area of timberland by county and stand-size class,
Prairie Unit, Minnesota, 1990

(In thousand acres)

County or county group	All stands	Stand-size class			
		Sawtimber	Poletimber	Seedling & sapling	Nonstocked
Blue Earth-Faribault	32.0	22.8	4.4	4.4	0.4
Clay-Norman	38.5	20.3	7.5	10.0	0.7
Eastern group	34.7	25.5	3.5	5.4	0.3
Kandiyohi-Meeker	39.9	27.7	4.4	7.4	0.4
Kittson	54.0	16.4	17.3	19.7	0.6
Marshall	138.7	26.9	51.7	58.9	1.2
Northern group	67.7	49.3	7.4	10.3	0.7
Pennington-Red Lake	59.9	20.1	20.0	19.3	0.5
Polk	55.7	22.2	17.8	15.2	0.5
Southern group	40.9	28.1	4.6	7.7	0.5
Western group	81.8	53.3	10.9	16.4	1.2
All counties	643.8	312.6	149.5	174.7	7.0

Table 5.--Area of timberland by county and potential productivity class,
Prairie Unit, Minnesota, 1990

(In thousand acres)

County or county group	All classes	Site class (cubic feet of growth per acre per year)				
		165+	120-164	85-119	50-84	20-49
Blue Earth-Faribault	32.0	0.3	0.7	4.7	9.8	16.5
Clay-Norman	38.5	0.3	0.5	5.1	14.5	18.1
Eastern group	34.7	0.5	0.5	5.0	8.5	20.2
Kandiyohi-Meeker	39.9	0.5	0.6	5.7	10.9	22.2
Kittson	54.0	--	0.5	7.6	23.0	22.9
Marshall	138.7	0.3	0.3	20.6	60.7	56.8
Northern group	67.7	0.6	1.1	10.6	17.9	37.5
Pennington-Red Lake	59.9	0.1	0.5	8.3	25.1	25.9
Polk	55.7	--	0.7	8.1	23.1	23.8
Southern group	40.9	0.5	0.7	5.7	12.0	22.0
Western group	81.8	0.9	1.4	11.0	27.1	41.4
All counties	643.8	4.0	7.5	92.4	232.6	307.3

Table 6.--Area of timberland by county and stocking class of growing-stock trees¹,
Prairie Unit, Minnesota, 1990

(In thousand acres)

County or county group	All classes	Stocking percent of growing-stock trees				
		Non-stocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
Blue Earth-Faribault	32.0	1.0	10.3	16.6	3.8	0.3
Clay-Norman	38.5	1.3	11.5	17.9	5.7	2.1
Eastern group	34.7	1.4	10.2	17.8	4.2	1.1
Kandiyohi-Meeker	39.9	1.6	11.6	20.2	5.0	1.5
Kittson	54.0	1.7	15.6	20.7	10.6	5.4
Marshall	138.7	3.9	38.9	50.2	28.9	16.8
Northern group	67.7	2.5	19.2	35.1	8.1	2.8
Pennington-Red Lake	59.9	1.8	16.8	23.4	11.9	6.0
Polk	55.7	1.5	16.1	23.1	10.3	4.7
Southern group	40.9	1.6	12.1	20.9	5.0	1.3
Western group	81.8	2.8	25.0	41.7	10.0	2.3
All counties	643.8	21.0	186.9	287.0	103.3	44.2

¹ This table is based on the stocking percent of growing-stock trees rather than that of all live trees. To use the definitions of stocking for this table, replace the term "all live" by "growing-stock."

Table 7.--Area of timberland by ownership class and stocking class of growing-stock trees¹,
Prairie Unit, Minnesota, 1990

(In thousand acres)

Ownership class	All classes	Stocking percent of growing-stock trees				
		Non-stocked	Poorly stocked	Moderately stocked	Fully stocked	Over-stocked
Miscellaneous federal	13.8	1.1	2.3	3.1	5.1	2.2
State	77.9	4.4	21.8	17.7	17.4	16.6
County and municipal	7.0	--	4.6	--	2.4	--
Forest Industry	--	--	--	--	--	--
Farmer	371.7	12.6	106.8	181.7	53.6	17.0
Miscellaneous private corporation	20.9	1.9	8.5	8.3	1.1	1.1
Miscellaneous private individual	152.5	1.1	43.3	76.8	23.9	7.4
All owners	643.8	21.1	187.3	287.6	103.5	44.3

¹ This table is based on the stocking percent of growing-stock trees rather than that of all live trees. To use the definitions of stocking for this table, replace the term "all live" by "growing-stock."

Table 8.--Area of timberland by forest type and ownership class, Prairie Unit, Minnesota, 1990

(In thousand acres)

Forest type	All owners	Ownership class							
		National forest	Misc. federal	State	County & municipal	Forest industry	Farmer	Misc. private corporation	Misc. private individual
Red pine	1.1	--	--	1.1	--	--	--	--	--
White pine	1.0	--	--	1.0	--	--	--	--	--
Black spruce	2.0	--	--	2.0	--	--	--	--	--
Tamarack	5.2	--	--	5.2	--	--	--	--	--
Oak-hickory	122.8	--	--	5.0	--	--	82.6	2.1	33.1
Elm-ash-soft-maple	103.0	--	3.1	8.9	1.2	--	66.4	4.4	19.0
Maple-basswood	161.9	--	1.2	4.2	2.3	--	107.5	4.1	42.6
Aspen	211.9	--	5.3	43.2	3.5	--	101.1	7.3	51.5
Balsam poplar	27.9	--	3.1	5.5	--	--	11.9	1.1	6.3
Nonstocked	7.0	--	1.1	1.8	--	--	2.2	1.9	--
All types	643.8	--	13.8	77.9	7.0	--	371.7	20.9	152.5

Table 9.--Area of timberland by forest type and stand-size class,
Prairie Unit, Minnesota, 1990

(In thousand acres)

Forest type	All stands	Stand-size class			
		Sawtimber	Poletimber	Seedling & sapling	Nonstocked
Red pine	1.1	1.1	--	--	--
White pine	1.0	1.0	--	--	--
Black spruce	2.0	--	1.1	0.9	--
Tamarack	5.2	--	1.1	4.1	--
Oak-hickory	122.8	98.5	8.8	15.5	--
Elm-ash-soft-maple	103.0	68.7	17.6	16.7	--
Maple-basswood	161.9	118.9	18.0	25.0	--
Aspen	211.9	24.4	85.6	101.9	--
Balsam poplar	27.9	--	17.3	10.6	--
Nonstocked	7.0	--	--	--	7.0
All types	643.8	312.6	149.5	174.7	7.0

Table 10.--Number of all live trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

(In thousand trees)

		Diameter class (inches at breast height)											
Species group	All classes	1.0- 2.9	3.0- 4.9	5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 28.9	29.0+
Softwoods													
Jack pine	14	--	--	--	--	8	6	--	--	--	--	--	--
Red pine	18	--	--	--	--	--	--	8	3	3	4	--	--
White pine	78	--	--	20	11	16	14	17	--	--	--	--	--
White spruce	127	33	66	--	--	12	4	4	6	--	2	--	--
Black spruce	2,089	1,170	651	217	51	--	--	--	--	--	--	--	--
Balsam fir	1,230	660	429	129	12	--	--	--	--	--	--	--	--
Tamarack	928	153	213	409	124	25	--	4	--	--	--	--	--
Eastern redcedar	4,262	2,034	1,125	624	320	92	51	4	10	2	--	--	--
Total	8,746	4,050	2,484	1,399	518	153	75	37	19	5	6	--	--
Hardwoods													
White oak	20,100	6,710	2,927	2,527	1,549	1,623	1,581	1,076	756	573	330	402	46
Select red oak	2,589	768	93	39	466	272	225	278	182	103	61	79	23
Other red oak	36	--	--	--	--	--	--	--	6	8	2	20	--
Hickory	1,124	690	117	198	29	33	25	22	--	4	6	--	--
Basswood	15,901	9,432	2,118	1,190	536	513	539	473	437	267	176	200	20
Yellow birch	55	--	--	26	14	15	--	--	--	--	--	--	--
Hard maple	5,415	2,701	911	717	346	233	160	167	82	55	28	15	--
Soft maple	2,324	1,296	480	160	58	35	98	48	34	22	7	58	28
Elm	22,650	12,317	5,514	2,560	928	527	348	127	104	59	54	81	31
Black ash	8,504	4,477	2,474	962	397	118	41	23	6	6	--	--	--
White and green ash	21,042	11,142	3,452	1,846	1,336	1,278	765	481	370	167	109	87	9
Cottonwood	1,637	432	150	152	152	199	156	66	90	39	35	96	70
Willow	3,422	1,284	114	210	505	473	368	202	111	68	33	49	5
Hackberry	6,744	4,599	1,407	347	207	64	40	26	28	11	2	12	1
Balsam poplar	21,199	11,537	4,162	2,076	1,751	1,136	320	157	40	17	2	--	1
Bigtooth aspen	311	159	45	39	63	--	5	--	--	--	--	--	--
Quaking aspen	99,275	56,767	17,467	10,395	7,458	4,470	1,979	511	180	29	13	6	--
Paper birch	837	195	159	237	145	56	32	9	--	4	--	--	--
Black cherry	4,854	4,200	373	126	48	82	--	12	10	--	3	--	--
Black walnut	480	204	36	--	114	39	18	25	24	7	10	3	--
Butternut	271	66	132	29	12	14	11	3	3	--	--	--	1
Other hardwoods	25,403	12,103	5,092	3,494	1,973	1,092	741	415	242	120	57	69	5
Noncommercial sp.	28,042	21,630	4,549	1,517	244	85	14	--	--	3	--	--	--
Total	292,215	162,709	51,772	28,847	18,331	12,357	7,466	4,121	2,705	1,562	928	1,177	240
All species	300,961	166,759	54,256	30,246	18,849	12,510	7,541	4,158	2,724	1,567	934	1,177	240

Table 11.--Number of growing-stock trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

(In thousand trees)

		Diameter class (inches at breast height)											
	All	1.0-	3.0-	5.0-	7.0-	9.0-	11.0-	13.0-	15.0-	17.0-	19.0-	21.0-	
Species group	classes	2.9	4.9	6.9	8.9	10.9	12.9	14.9	16.9	18.9	20.9	28.9	29.0+
Softwoods													
Jack pine	14	--	--	--	--	8	6	--	--	--	--	--	--
Red pine	18	--	--	--	--	--	--	8	3	3	4	--	--
White pine	78	--	--	20	11	16	14	17	--	--	--	--	--
White spruce	127	33	66	--	--	12	4	4	6	--	2	--	--
Black spruce	2,035	1,143	624	217	51	--	--	--	--	--	--	--	--
Balsam fir	1,230	660	429	129	12	--	--	--	--	--	--	--	--
Tamarack	928	153	213	409	124	25	--	4	--	--	--	--	--
Eastern redcedar	3,889	1,974	1,056	464	263	65	51	4	10	2	--	--	--
Total	8,319	3,963	2,388	1,239	461	126	75	37	19	5	6	--	--
Hardwoods													
White oak	16,933	6,490	2,562	1,972	1,266	1,303	1,120	812	526	394	237	235	16
Select red oak	2,194	768	93	22	401	176	186	220	142	87	38	51	10
Other red oak	27	--	--	--	--	--	--	--	6	4	--	17	--
Hickory	1,077	657	117	198	29	33	19	22	--	--	2	--	--
Basswood	13,867	8,913	1,752	876	377	371	361	371	335	228	134	138	11
Yellow birch	47	--	--	26	14	7	--	--	--	--	--	--	--
Hard maple	4,820	2,668	884	561	298	102	95	105	54	40	7	6	--
Soft maple	1,694	1,044	288	137	27	18	69	30	22	18	5	26	10
Elm	20,339	12,179	4,629	2,036	604	366	217	87	73	45	33	49	21
Black ash	7,814	4,291	2,135	842	386	100	35	19	3	3	--	--	--
White and green ash	18,624	11,109	2,942	1,317	1,015	944	465	338	261	103	74	49	7
Cottonwood	1,552	432	150	127	152	199	124	59	87	39	35	91	57
Willow	2,680	1,284	57	78	380	345	255	113	82	36	25	25	--
Hackberry	6,135	4,536	1,122	221	133	33	31	22	19	11	2	4	1
Balsam poplar	19,139	11,202	3,494	1,691	1,435	927	228	112	30	17	2	--	1
Bigtooth aspen	311	159	45	39	63	--	5	--	--	--	--	--	--
Quaking aspen	90,044	55,105	15,688	8,654	5,641	3,237	1,306	293	101	10	9	--	--
Paper birch	775	195	159	237	114	42	22	4	--	2	--	--	--
Black cherry	4,413	4,041	283	47	--	25	--	12	5	--	--	--	--
Black walnut	407	177	36	--	114	28	12	18	11	7	2	2	--
Butternut	241	66	132	--	12	14	11	3	3	--	--	--	--
Other hardwoods	17,316	11,128	2,986	1,547	830	437	166	110	69	35	--	8	--
Total	230,449	136,444	39,554	20,628	13,291	8,707	4,727	2,750	1,829	1,079	605	701	134
All species	238,768	140,407	41,942	21,867	13,752	8,833	4,802	2,787	1,848	1,084	611	701	134

Table 12.--Net volume of timber on timberland by class of timber and species group, Prairie Unit, Minnesota, 1990

(In thousand cubic feet)

Class of timber	All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Live trees					
Growing-stock trees					
Sawtimber					
Saw-log portion	254,742	1,370	2,731	121,772	128,869
Upper stem portion	91,359	182	390	44,746	46,041
Total	346,101	1,552	3,121	166,518	174,910
Poletimber	219,273	92	6,101	144,727	68,353
All growing-stock trees	565,374	1,644	9,222	311,245	243,263
Cull trees					
Short-log trees	50,010	--	115	17,023	32,872
Rough trees					
Sawtimber	74,854	--	94	26,150	48,610
Poletimber	61,451	--	520	31,660	29,271
Total	136,305	--	614	57,810	77,881
Rotten trees					
Sawtimber	17,961	--	--	9,718	8,243
Poletimber	5,014	--	--	3,614	1,400
Total	22,975	--	--	13,332	9,643
All cull trees	209,290	--	729	88,165	120,396
All live trees	774,664	1,644	9,951	399,410	363,659
Salvable dead trees					
Sawtimber	26,797	--	88	23,576	3,133
Poletimber	11,961	--	69	10,332	1,560
Total	38,758	--	157	33,908	4,693
All classes of timber	813,422	1,644	10,108	433,318	368,352

Table 13.--Net volume of growing-stock trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)									
		5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods											
Jack pine	186	--	--	91	95	--	--	--	--	--	--
Red pine	656	--	--	--	--	195	118	111	232	--	--
White pine	802	40	52	117	209	384	--	--	--	--	--
White spruce	679	--	--	152	84	85	189	--	169	--	--
Black spruce	872	623	249	--	--	--	--	--	--	--	--
Balsam fir	418	345	73	--	--	--	--	--	--	--	--
Tamarack	2,323	1,274	706	246	--	97	--	--	--	--	--
Eastern redcedar	4,930	1,348	1,483	715	850	106	319	109	--	--	--
Total	10,866	3,630	2,563	1,321	1,238	867	626	220	401	--	--
Hardwoods											
White oak	116,362	4,396	6,372	11,855	15,841	16,684	15,287	14,636	11,251	17,578	2,462
Select red oak	27,011	45	2,158	1,760	2,767	4,808	4,371	3,471	1,941	4,126	1,564
Other red oak	1,146	--	--	--	--	--	159	145	--	842	--
Hickory	1,590	387	131	238	254	482	--	--	98	--	--
Basswood	64,697	2,299	2,442	4,046	6,225	8,873	11,180	9,720	7,122	11,077	1,713
Yellow birch	211	54	71	86	--	--	--	--	--	--	--
Hard maple	13,570	1,668	1,944	1,112	1,577	2,676	1,852	1,790	430	521	--
Soft maple	8,333	445	211	238	1,168	764	709	879	275	2,101	1,543
Elm	29,450	4,632	3,184	3,487	3,416	1,907	2,256	1,731	1,728	3,774	3,335
Black ash	6,918	2,324	2,291	1,049	544	488	103	119	--	--	--
White and green ash	54,949	3,261	5,817	9,126	7,178	7,675	8,141	4,403	4,229	4,070	1,049
Cottonwood	29,844	242	783	1,882	1,982	1,280	2,768	1,564	1,757	7,289	10,297
Willow	18,952	197	1,908	3,296	3,761	2,583	2,487	1,360	1,290	2,070	--
Hackberry	4,144	578	641	342	430	484	578	471	121	342	157
Balsam poplar	30,499	4,641	8,302	9,409	3,701	2,573	952	676	116	--	129
Bigtooth aspen	572	105	392	--	75	--	--	--	--	--	--
Quaking aspen	120,711	22,343	32,921	33,110	21,045	7,072	3,241	496	483	--	--
Paper birch	2,537	728	733	499	374	104	--	99	--	--	--
Black cherry	904	179	--	281	--	293	151	--	--	--	--
Black walnut	2,641	--	731	306	224	480	375	306	116	103	--
Butternut	602	--	62	169	207	81	83	--	--	--	--
Other hardwoods	18,865	3,150	4,339	3,682	2,116	2,166	1,788	1,228	--	396	--
Total	554,508	51,674	75,433	85,973	72,885	61,473	56,481	43,094	30,957	54,289	22,249
All species	565,374	55,304	77,996	87,294	74,123	62,340	57,107	43,314	31,358	54,289	22,249

Table 14.--Net volume of growing stock in the saw-log portion of sawtimber trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

(In thousand cubic feet)

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Jack pine	160	77	83	--	--	--	--	--	--
Red pine	611	--	--	182	110	103	216	--	--
White pine	599	87	178	334	--	--	--	--	--
White spruce	619	133	77	78	175	--	156	--	--
Black spruce	--	--	--	--	--	--	--	--	--
Balsam fir	--	--	--	--	--	--	--	--	--
Tamarack	294	205	--	89	--	--	--	--	--
Eastern redcedar	1,818	588	745	96	290	99	--	--	--
Total	4,101	1,090	1,083	779	575	202	372	--	--
Hardwoods									
White oak	68,787	--	10,218	11,922	11,373	11,109	8,630	13,608	1,927
Select red oak	17,082	--	1,767	3,440	3,271	2,651	1,489	3,222	1,242
Other red oak	898	--	--	--	121	111	--	666	--
Hickory	541	--	146	322	--	--	73	--	--
Basswood	42,580	--	4,268	6,543	8,564	7,550	5,582	8,700	1,373
Yellow birch	--	--	--	--	--	--	--	--	--
Hard maple	6,449	--	1,023	1,927	1,391	1,367	332	409	--
Soft maple	5,507	--	722	537	521	660	212	1,628	1,227
Elm	13,014	--	2,071	1,311	1,621	1,273	1,289	2,863	2,586
Black ash	914	--	369	369	81	95	--	--	--
White and green ash	27,318	--	4,794	5,622	6,206	3,393	3,278	3,189	836
Cottonwood	20,053	--	1,153	827	1,953	1,131	1,300	5,532	8,157
Willow	9,129	--	2,158	1,709	1,743	981	953	1,585	--
Hackberry	1,841	--	260	340	419	351	90	259	122
Balsam poplar	5,798	--	2,465	1,894	725	524	89	--	101
Bigtooth aspen	50	--	50	--	--	--	--	--	--
Quaking aspen	22,817	--	14,306	5,266	2,479	387	379	--	--
Paper birch	387	--	238	74	--	75	--	--	--
Black cherry	330	--	--	214	116	--	--	--	--
Black walnut	1,229	--	157	362	295	240	92	83	--
Butternut	266	--	141	61	64	--	--	--	--
Other hardwoods	5,651	--	1,413	1,602	1,370	953	--	313	--
Total	250,641	--	47,719	44,342	42,313	32,851	23,788	42,057	17,571
All species	254,742	1,090	48,802	45,121	42,888	33,053	24,160	42,057	17,571

Table 15.--Net volume of sawtimber trees on timberland by species group and diameter class, Prairie Unit, Minnesota, 1990

(In thousand board feet)

Species group	All classes	Diameter class (inches at breast height)							
		9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0+
Softwoods									
Jack pine	910	440	470	--	--	--	--	--	--
Red pine	3,635	--	--	1,044	649	620	1,322	--	--
White pine	3,474	555	1,009	1,910	--	--	--	--	--
White spruce	3,722	782	447	454	1,045	--	994	--	--
Black spruce	--	--	--	--	--	--	--	--	--
Balsam fir	--	--	--	--	--	--	--	--	--
Tamarack	1,754	1,234	--	520	--	--	--	--	--
Eastern redcedar	11,076	3,641	4,447	579	1,787	622	--	--	--
Total	24,571	6,652	6,373	4,507	3,481	1,242	2,316	--	--
Hardwoods									
White oak	432,501	--	64,849	72,978	69,786	68,975	54,504	88,401	13,008
Select red oak	107,706	--	11,177	21,030	20,076	16,484	9,412	21,085	8,442
Other red oak	5,671	--	--	--	746	691	--	4,234	--
Hickory	3,422	--	972	1,989	--	--	461	--	--
Basswood	268,487	--	26,799	40,240	52,962	47,269	35,387	56,629	9,201
Yellow birch	--	--	--	--	--	--	--	--	--
Hard maple	40,641	--	6,576	11,976	8,664	8,625	2,126	2,674	--
Soft maple	35,811	--	4,664	3,340	3,247	4,175	1,354	10,661	8,370
Elm	84,054	--	13,361	8,134	10,068	7,968	8,178	18,640	17,705
Black ash	5,730	--	2,358	2,271	505	596	--	--	--
White and green ash	170,112	--	29,844	34,069	37,985	21,120	20,748	20,716	5,630
Cottonwood	131,685	--	7,294	5,056	11,975	7,015	8,183	36,015	56,147
Willow	57,392	--	13,886	10,443	10,664	6,075	5,991	10,333	--
Hackberry	11,692	--	1,703	2,116	2,596	2,205	576	1,674	822
Balsam poplar	36,161	--	15,502	11,644	4,482	3,275	568	--	690
Bigtooth aspen	314	--	314	--	--	--	--	--	--
Quaking aspen	142,359	--	89,946	32,271	15,302	2,432	2,408	--	--
Paper birch	2,439	--	1,505	461	--	473	--	--	--
Black cherry	2,054	--	--	1,332	722	--	--	--	--
Black walnut	7,701	--	998	2,243	1,837	1,505	587	531	--
Butternut	1,660	--	886	378	396	--	--	--	--
Other hardwoods	35,009	--	8,954	9,778	8,373	5,908	--	1,996	--
Total	1,582,601	--	301,588	271,749	260,386	204,791	150,483	273,589	120,015
All species	1,607,172	6,652	307,961	276,256	263,867	206,033	152,799	273,589	120,015

Table 16.--Net volume of growing stock and sawtimber on timberland by county and species group, Prairie Unit, Minnesota, 1990

County	Growing-stock					Sawtimber				
	All species	Species group				All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	----- Thousand cubic feet -----					----- Thousand board feet ¹ -----				
Blue Earth-Fairbault	31,648	13	431	14,496	16,708	107,602	91	1,019	48,531	57,961
Clay-Norman	33,266	109	490	18,342	14,325	101,871	514	1,026	53,259	47,072
Eastern group	35,864	58	651	13,258	21,897	130,460	289	1,311	47,283	81,577
Kandiyohi-Meeker	39,547	81	667	15,918	22,881	143,058	365	1,398	57,104	84,191
Kittson	40,408	236	750	27,573	11,849	86,293	1,161	1,123	50,240	33,769
Marshall	95,099	540	2,000	70,914	21,645	153,674	2,751	2,404	96,751	51,768
Northern group	73,342	75	917	32,199	40,151	260,227	334	2,037	113,547	144,309
Pennington-Red Lake	48,151	201	846	31,699	15,405	105,401	1,023	1,222	58,198	44,958
Polk	47,326	113	661	31,007	15,545	110,885	606	1,050	64,031	45,198
Southern group	40,276	78	622	17,439	22,137	143,152	355	1,373	61,448	79,976
Western group	74,097	106	1,084	34,913	37,994	260,188	548	2,558	122,304	134,778
All counties	559,024	1,610	9,119	307,758	240,537	1,602,811	8,037	16,521	772,696	805,557

¹ International 1/4-inch rule.

Table 17.--Net volume of live trees and growing stock on timberland by ownership class and species group, Prairie Unit, Minnesota, 1990

(In thousand cubic feet)

Ownership class	Live trees					Growing stock				
	All species	Species group				All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
National forest	--	--	--	--	--	--	--	--	--	--
Miscellaneous federal	12,451	--	--	9,791	2,660	9,935	--	--	7,912	2,023
State	58,675	1,644	3,607	41,213	12,211	46,556	1,644	3,607	33,654	7,651
County and municipal	10,008	--	--	6,263	3,745	7,926	--	--	4,936	2,990
Forest industry	--	--	--	--	--	--	--	--	--	--
Farmer	466,212	--	4,481	220,658	241,073	330,694	--	3,752	166,078	160,864
Miscellaneous private corporation	22,561	--	--	10,842	11,719	15,727	--	--	8,396	7,331
Miscellaneous private individual	204,757	--	1,863	110,643	92,251	154,536	--	1,863	90,269	62,404
All owners	774,664	1,644	9,951	399,410	363,659	565,374	1,644	9,222	311,245	243,263

Table 18.--Net volume of sawtimber trees on timberland by species group and butt log grade,
Prairie Unit, Minnesota, 1990

(In thousand board feet)¹

Species group	All grades	Butt log grade			
		1	2	3	Tie and timber
Softwoods					
Jack pine	910	5	59	846	--
Red pine	3,635	370	660	2,605	--
White pine	3,474	618	1,067	1,469	320
White spruce	3,722	60	267	3,395	--
Black spruce	--	--	--	--	--
Tamarack	1,754	--	89	1,665	--
Eastern redcedar	11,076	--	1,880	9,196	--
Total	24,571	1,053	4,022	19,176	320
Hardwoods					
White oak	432,501	26,682	48,016	155,495	202,308
Select red oak	107,706	4,387	26,911	47,371	29,037
Other red oak	5,671	--	--	4,571	1,100
Hickory	3,422	--	--	2,434	988
Basswood	268,487	103,959	66,334	91,539	6,655
Yellow birch	--	--	--	--	--
Hard maple	40,641	8,487	11,892	12,339	7,924
Soft maple	35,811	10,970	4,897	6,093	13,850
Elm	84,054	2,635	21,169	23,531	36,719
Black ash	5,730	--	--	--	5,730
White and green ash	170,112	27,777	38,239	79,877	24,220
Cottonwood	131,685	25,748	36,482	54,431	15,024
Willow	57,392	--	7,061	--	50,331
Hackberry	11,692	--	4,182	7,510	--
Balsam poplar	36,161	--	--	15,022	21,139
Bigtooth aspen	314	--	--	106	208
Quaking aspen	142,359	--	--	47,962	94,397
Paper birch	2,439	--	--	822	1,617
Black cherry	2,054	--	--	2,054	--
Black walnut	7,701	--	3,497	4,204	--
Butternut	1,660	--	754	906	--
Other hardwoods	35,009	--	5,122	4,429	25,458
Total	1,582,601	210,644	274,556	560,694	536,706
All species	1,607,172	211,697	278,578	579,870	537,026

¹ International 1/4-inch rule.

Table 19.--Average net annual growth of growing stock and sawtimber on timberland by county and species group,
Prairie Unit, Minnesota, 1977-1989

County	Growing stock					Sawtimber				
	All species	Species group				All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	----- Thousand cubic feet -----						----- Thousand board feet ¹ -----			
Blue Earth-Faribault	934	--	133	513	288	3,099	--	289	1,429	1,381
Clay-Norman	561	--	--	57	504	3,866	--	--	925	2,941
Eastern group	818	--	8	148	662	4,710	--	44	912	3,754
Kandiyohi-Meeker	809	--	19	293	497	4,173	--	--	2,025	2,148
Kittson	1,036	--	--	707	329	1,181	--	--	-58	1,239
Marshall	2,403	--	181	1,824	398	4,012	--	102	3,032	878
Northern group	790	--	13	263	514	3,871	--	39	856	2,976
Pennington-Red Lake	1,190	--	--	782	408	4,116	--	--	2,353	1,763
Polk	1,469	5	-6	905	565	5,649	51	-35	3,232	2,401
Southern group	696	--	62	120	514	1,891	--	211	-67	1,747
Western group	1,031	46	16	274	695	4,806	221	92	1,198	3,295
All counties	11,737	51	426	5,886	5,374	41,374	272	742	15,837	24,523

¹International 1/4-inch rule.

Table 20.--Average annual removals of growing stock and sawtimber on timberland by county and species group,
Prairie Unit, Minnesota, 1977-1989

County	Growing stock					Sawtimber				
	All species	Species group				All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
	----- Thousand cubic feet -----					----- Thousand board feet ¹ -----				
Blue Earth-Faribault	143	--	--	95	48	553	--	--	352	201
Clay-Norman	1,136	--	--	471	665	3,497	--	--	1,478	2,019
Eastern group	595	--	--	159	436	2,299	--	--	587	1,712
Kandiyohi-Meeker	15	--	--	15	--	84	--	--	84	--
Kittson	159	--	--	151	8	49	--	--	49	--
Marshall	1,325	--	22	1,024	279	1,117	--	--	585	532
Northern group	486	--	--	288	198	2,059	--	--	1,110	949
Pennington-Red Lake	467	--	--	353	114	848	--	--	570	278
Polk	2,268	--	--	1,726	542	5,777	--	--	3,817	1,960
Southern group	120	--	--	77	43	392	--	--	255	137
Western group	481	--	--	195	286	2,028	--	--	698	1,330
All counties	7,195	--	22	4,554	2,619	18,703	--	--	9,585	9,118

¹International 1/4-inch rule.

Table 21.--Average net annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Prairie Unit, Minnesota, 1977-1989

Species group	Growing stock			Sawtimber		
	Net growth ¹	Mortality	Removals	Net growth ¹	Mortality	Removals
	----- Thousand cubic feet -----			----- Thousand board feet ² -----		
Softwoods						
Jack pine	-7	12	--	-14	36	--
Red pine	15	--	--	81	--	--
White pine	43	--	--	205	2	--
White spruce	17	7	6	92	42	--
Black spruce	36	10	--	--	--	--
Balsam fir	42	--	--	--	--	--
Tamarack	96	28	16	67	2	--
Eastern redcedar	235	--	--	583	--	--
Total	477	57	22	1,014	82	--
Hardwoods						
White oak	1,885	197	1,410	11,684	808	4,460
Select red oak	452	218	395	2,847	719	1,727
Other red oak	-5	25	9	144	71	42
Hickory	79	3	4	181	4	--
Basswood	1,164	370	476	5,881	1,637	2,212
Yellow birch	11	--	--	--	--	--
Hard maple	128	67	72	1,136	158	242
Soft maple	180	14	15	1,382	41	84
Elm	-1,606	3,385	950	-8,863	11,360	3,323
Black ash	198	28	56	353	5	33
White and green ash	1,943	180	469	6,999	527	2,176
Cottonwood	705	265	172	4,040	835	832
Willow	278	200	40	1,764	592	136
Hackberry	197	22	8	323	100	--
Balsam poplar	894	684	571	1,931	780	652
Bigtooth aspen	35	1	--	21	4	--
Quaking aspen	3,923	2,942	2,243	9,074	2,563	2,289
Paper birch	-8	98	40	-128	128	--
Black cherry	-26	36	28	203	111	--
Black walnut	62	9	7	228	52	--
Butternut	150	--	11	209	5	57
Other hardwoods	621	251	197	951	316	438
Total	11,260	8,995	7,173	40,360	20,816	18,703
All species	11,737	9,052	7,195	41,374	20,898	18,703

¹An estimate of average gross growth may be computed by adding average mortality to average net growth.

²International 1/4-inch rule.

Table 22.--Average net annual growth and average annual removals of growing stock on timberland by ownership class and species group,
Prairie Unit, Minnesota, 1977-1989

(In thousand cubic feet)

Ownership class	Growth					Removals				
	All species	Species group				All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Miscellaneous federal	182	--	--	145	37	--	--	--	--	--
State	1,467	51	170	949	297	218	--	--	163	55
County and municipal	278	--	--	171	107	94	--	--	70	24
Forest industry	26	--	--	18	8	67	--	--	41	26
Farmer	6,585	--	154	2,851	3,580	4,283	--	22	2,472	1,789
Miscellaneous private corporation	281	--	--	81	200	551	--	--	536	15
Miscellaneous private individual	2,918	--	102	1,671	1,145	1,982	--	--	1,272	710
All owners	11,737	51	426	5,886	5,374	7,195	--	22	4,554	2,619

Table 23--Average net annual growth and average annual removals of sawtimber on timberland by ownership class and species group,
Prairie Unit, Minnesota, 1977-1989

(In thousand board feet)¹

Ownership class	Growth					Removals				
	All species	Species group				All species	Species group			
		Pine	Other softwoods	Soft hardwoods	Hard hardwoods		Pine	Other softwoods	Soft hardwoods	Hard hardwoods
Miscellaneous federal	968	--	--	820	148	--	--	--	--	--
State	3,604	272	198	2,366	768	37	--	--	37	--
County and municipal	787	--	--	443	344	425	--	--	318	107
Forest industry	18	--	--	18	--	65	--	--	65	--
Farmer	24,747	--	315	8,117	16,315	11,650	--	--	5,163	6,487
Miscellaneous private corporation	1,096	--	--	437	659	534	--	--	496	38
Miscellaneous private individual	10,154	--	229	3,636	6,289	5,992	--	--	3,506	2,486
All owners	41,374	272	742	15,837	24,523	18,703	--	--	9,585	9,118

¹International 1/4-inch rule.

Table 24.--Current annual growth, mortality, and removals of growing stock and sawtimber on timberland by species group, Prairie Unit, Minnesota, 1989

Species group	Growing stock			Sawtimber		
	1989 Net growth ¹	1989 Mortality	1988 Removals ²	1989 Net growth ¹	1989 Mortality	1988 Removals ²
	----- Thousand cubic feet -----			----- Thousand board feet ³ -----		
Softwoods						
Jack pine	-3	6	1	-16	30	7
Red pine	15	--	2	81	--	15
White pine	43	--	1	205	2	4
Spruce	47	20	6	167	1	--
Balsam fir	51	5	--	--	--	--
Tamarack	82	--	19	195	10	15
Eastern redcedar	231	28	1	721	--	4
Total	466	59	30	1,353	43	45
Hardwoods						
White oak	2,572	19	899	11,785	660	2,781
Red oak	516	292	281	2,685	1,129	1,150
Basswood	1,282	437	228	5,299	2,007	1,122
Yellow birch	7	3	1	--	--	7
Hard maple	322	29	311	1,007	108	634
Soft maple	235	20	176	1,302	96	500
Elm	953	802	1,033	275	2,156	3,960
Ash	2,475	173	648	7,916	420	2,186
Cottonwood	712	72	607	4,041	332	2,922
Balsam poplar	1,083	647	541	2,963	808	593
Aspen	5,655	3,267	1,558	14,934	3,472	1,918
Paper birch	35	47	32	161	40	61
Other hardwoods	1,931	614	312	3,941	1,421	869
Total	17,778	6,422	6,627	56,309	12,649	18,703
All species	18,244	6,481	6,657	57,662	12,692	18,748

¹An estimate of current gross growth may be computed by adding current mortality to current net growth.

²Based on data from a 1988 mill survey and a 1989-1990 logging utilization study, and on land use change estimates from the new inventory.

³International 1/4-inch rule.

Roussopoulos, Sue M.

1992. **Forest statistics for Minnesota's Prairie Unit.** Resour. Bull. NC-138. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. 45 p.

The fifth inventory of Minnesota's Prairie Unit reports 19.2 million acres of land, of which 660 thousand acres are forested. This bulletin presents statistical highlights and contains detailed tables of forest area, as well as timber volume, growth, removals, mortality, and ownership.

KEY WORDS: Forest area, timber volume, growth, removals, mortality.

Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.

